INTERNATIONAL GEOSCIENCE PROGRAMME (IGCP)

Annual Report* of IGCP Project No.495

IGCP project short title: **Quaternary Land-Ocean interactions**

Duration: **5 years 2004 – 2009**

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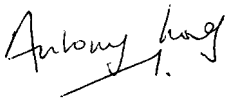
Signature of project leader(s): 

1. Website address related to the project

http://www.geography.dur.ac.uk/projects/igcp495

2. Summary of major past achievements of the project

Four international project conferences and field trips with seven regional / thematic meetings. Two hundred and fifty project members. Special issue of *Marine Geology* published 2007.

3. Achievements of the project this year only

3.1. Countries involved in the project: Argentina, Austria, Australia*, Bangladesh, Belgium*, Brazil*, Canada*, China*, Denmark*, Ecuador, Estonia, Ethiopia, Fiji, Finland*, France*, Germany*, Greece*, India*, Indonesia*, Israel*, Italy*, Jamaica, Japan*, Kenya, Malaysia*, Morocco, Mozambique*, New Zealand*, Norway, Portugal*, Ireland*, S. Korea*, Spain, Singapore*, Sweden*, Switzerland*, Taiwan, Thailand*, The Netherlands*, Turkey, Ukraine*, UK*, UAE, USA*, Venezuela.

3.2. General scientific achievements and social benefits: Given the restricted space available here, this report details only the main scientific achievements published in international journals by IGCP495 members, structured around the separate elements of the project.

A. The vertical dimension of sea-level change: i) Quaternary timescales: Important long-term sea-level records have been published regarding the uplifted marine deposits of the Cape Verde archipelago (Zazo *et al.*, 2007), the drowned river valleys from North Carolina (Parham *et al.*, 2007), the Mississippi and Alambama inner continental shelves (Greene *et al.*, 2007) and the Japan Sea (Yokoyama *et al.*, 2007). A detailed sedimentary record colleted from the former Gulf of Carpentaria (the drowned area between Australia and New Guinea) provides a fascinating insight into the interplay of marine, lacustrine and terrestrial processes during the last 130 ka or so (Reeves *et al.*, 2007). The varying altitudes of these deposits, which range from +60 m in Cape Verde to -45 m in North Carolina, reflect the complex interaction of tectonic, volcanic and isostatic processes. **ii) Postglacial sea-level records:** Studies of vertical changes in sea-level since the last glacial maximum include research at sites near to (e.g. Scotland; de la Vega *et al.*, 2007; Selby *et al.*, 2007) and far from (e.g. Australia; Barry *et al.*, 2007; Kennedy *et al.*, 2007; Woodroffe *et al.*, 2007) the former ice sheets. New sea-level research from around Ireland is proving controversial, with disagreement between field observations and geophysical model predictions from the period immediately following ice retreat (Brooks *et al.*, in press; McCabe *et al.* 2007; Roberts *et al.*, 2007). The debates here will provide a focus for the 2008 UK IGCP field meeting to Northern Ireland. Holocene sea-level studies are improving in their resolution and generating new hypotheses regarding the driving mechanisms of sea-level change. For example, Bird *et al.* (2007) review early and mid Holocene sea-level data from Singapore, arguing for an inflection in global sea-level at c. 7400-7000 years ago. They correlate this event with the formation of stable shorelines and delta initiation elsewhere around the World at this time and attribute these changes to instability in the Antarctic Ice Sheet. In a similar manner, Yu *et al.* (2007) document a 4.5 m stepped rise in sea-level 7600 years ago based on data from the Baltic, although here they attribute the source of the ice melt to the Laurentide Ice Sheet. Meanwhile, Patterson *et al.* (2007) examine the driver of climate change (solar irradiance cyclicity and the Pacific Decadal Oscillation) as an agent of late Holocene environmental change using anoxic sediments from the Syemour-Belize inlet complex, British Columbia. **iii) Modelling, fluvial links:** We continue to interact productively with the geophysical modeling community and several papers demonstrate the power of integrating quality field observations with models to constrain vertical and lateral changes in sea-level and associated driving mechanisms (e.g. Simms *et al.*, 2007; Tarasov and Peltier 2007; Whitehouse *et al.* 2007). Finally, IGCP495 has a strong interest in links between fluvial and continental shelf records. Several papers document fluvial responses to vertical changes in sea-level, based largely on seismic and drill core evidence from the continental shelves (Egrin *et al.* 2007; Hill *et al.*, 2007; Matthues *et al.*, 2007; Tamura *et al.*, 2007; Thieler *et al.*, 2007).

B. The lateral dimension of sea-level change: i) Human impacts: Humans are important agents of coastal change, impacting on sediment delivery to the coastal zone as a result of coastal and catchment activity over a variety of timescales (e.g. Fletcher *et al.*, 2007; Moura *et al.* 2007). It is here that

IGCP495 interacts most closely with colleagues from archaeology in interdisciplinary research ventures (e.g. Bates *et al.*, 2007). Significant recent publications track the major changes in palaeoshorelines that occurred in the mid and late Holocene in the Lower Khuzestan Plan (Iran) (Heyvaert *et al.*, 2007) as well as in Anatolia (Kraft *et al.*, 2007), the Acheloos River delta (Vott *et al.*, 2007) and in the Jerf el Oustani Ras el Saaa region of Mauritania (Barusseau *et al.*, 2007). Coastal communities may be impacted by changes in shoreline and sea-level position, most often by storms and tsunami (see iii) below) but also by climate change. For example, Nunn *et al.* (2007) and Nunn (2007) document the impacts of a short-lived period of rapid cooling and sea-level fall at AD 1300 that caused societal collapse in the Pacific Basin islands. **ii) Methdological developments:** IGCP495 is committed to developing new methods to quantify past sea-level and coastal change. The last twelve months has seen continued developments in the field of microfossils including foraminifera (Berkeley *et al.*, 2007; Horton and Murray 2007; Riveiros *et al.*, 2007), diatoms (Hill *et al.*, 2007; Horton *et al.*, 2007) and pollen (Englehart *et al.*, 2007). Novel geochemical approaches to sediment finger-printing include a study of seasonality of delta C-13 and C/N rations from modern and mid Holocene tidal deposits (Allen *et al.*, 2007) and compound specific lipid biomarker analyses of saltmarsh sediments from Maine (Tanner *et al.*, 2007). Grain size determinations remain a mainstay of many coastal studies as demonstrated by Allen and Haslett (2007) in the Severn Estuary, UK, whilst high resolution ground penetrating radar is yielding important new insights into the episodes of dune erosion and scarp formation by storms during the last 1500 years (Buynevich *et al.*, 2007a, b). Lastly, several authors report recent advances in the use of optical dating techniques in intertidal areas and coastal dunes (e.g. Ballarini *et al.*, 2007; Mauz and Bugenstock 2007). **iii) Tsunami, hurricanes and storms:** This year saw the publication of an IGCP495 special issue of *Marine Geology* (Gehrels and Long, 2007) that included a set of papers arising from the IGCP495 Indonesia meeting (05). Several of these focus on the effects of the 2004 Indian Ocean tsunami, which has been a focus for numerous other publications by IGCP495 colleagues in the last year (Bird *et al.*, 2007; Hawkes *et al.*, 2007; Hori *et al.*, 2007; Kelletat *et al.*, 2007; Narayana *et al.*, 2007; Umitsu *et al.*, 2007). This tsunami provided an opportunity to further develop criteria to distinguish palaeotsunami deposits from those deposited by storms or other extreme events (e.g. Dawson and Stewart 2007; Kortekaas and Dawson 2007; Morton *et al.*, 2007). Other palaeotsunami publications include work in New Zealand (e.g. Nicholl *et al.*, 2007; McFadgen *et al.*, 2007), New Guinea (Dawson 2007), Italy (Mastronuzzi *et al.*, 2007), Newfoundland (Moore *et al.*, 2007), Greece (Scheffers and Scheffers 2007) and the Atlantic coasts of Britain, Ireland and France (Bryant and Haslett 2007; Haslett and Bryant 2007). As mentioned in section ii) above, new techniques are emerging that now enable identification of past hurricanes and storms that, when seen in conjunction with the rapid advances in tsunami research, is significantly improving our knowledge of the field of palaeotempestolgy (e.g. Buynevich *et al.*, 2007b; Cheung *et al.*, 2007; Ruiz *et al.*, 2007; Scileppi and Donnelly 2007).

3.3. List of meetings with approximate attendance and number of countries: Please see our website for details of previous meetings, including down-loadable reports, conference abstracts etc.

Title of Meeting	Date	Venue	Delegates	Countries
UK IGCP 495 / INQUA	1/7 – 4/7 2007	St Andrews, Scotland	20	4
Fourth International Meeting	28/7 – 6/8 2007	Cairns, Australia	50	19

3.4. Educational, training or capacity building activities: The Australia 07 International Meeting provided an opportunity for training in collection of sea-level data from a variety of depositional environments, including mangroves, coral reefs, cheniers and micro-atols. Our website provides a source of information regarding project members, previous meetings, and emerging research projects.

3.5. Participation of scientists from developing countries: IGCP495 is co-led by Prof. Islam (Bangladesh), who is very aware of the issues relating to sea-level change, coastal evolution and climate change and their impact on developing countries. 50 scientists attended the 07 International Meeting, with 10 young scientists directly participated in IGCP495 activities.

3.6. List of most important publications (all peer-reviewed)

Allen, J.R.L., *et al.* (2007). Seasonality of delta C-13 and C/N ratios in modern and mid-Holocene sediments in the Severn Estuary levels, SW Britain. *Holocene,* **17,** 139-144.

Allen, J.R.L., *et al* (2007). The Holocene estuarine sequence at Redwick, Welsh Severn Estuary Levels, UK: the character and role of silts. *Proceedings of the Geologists Association,* **118,** 157-174.

Ballarini, M., *et al* (2007). Analysis of equivalent-dose distributions for single grains of quartz from modern deposits. *Quaternary Geochronology*, **2**, 77-82.

Barry, S.J., *et al.* (2007). A morphodynamic model of reef-islands. *Sed. Geol.,* **197,** 47-63.

Barusseau, J P., *et al.* (2007). Late Holocene sedimentary forcing and human settlements in the Jerf el Oustani Ras el Sass region (Banc d'Arguin, Mauritania). *Geomorphologie-Relief Processes Environment,* (1): 7-18.

Bates, M.R., *et al.* (2007). Bridging the gap: a terrestrial view of shallow marine sequences and the importance of the transition zone. *Journal of Archaeological Science,* **34,** 1537-1551.

Bates, M.R., *et al.* (2007). Mixed method approaches to the investigation and mapping of buried quaternary deposits: examples from southern England. *Archaeological Prospection,* **14,** 104-129.

Berkeley, A., *et al.* (2007). A review of the ecological and taphonomic controls on foraminiferal assemblage development in intertidal environments. *Earth-Science Reviews,* **83,** 205-230.

Bird, M.I., *et al.* (2007). An inflection in the rate of early mid-Holocene eustatic sea-level rise: A new sea-level curve from Singapore. *Estuarine Coastal and Shelf Science,* **71,** 523-536.

Bird, M., *et al.* (2007). Indian Ocean tsunamis: environmental and socio-economic impacts in Langkawi, Malaysia. *Geographical Journal,* **173**,103-117.

Brooks, A.J., *et al.* (2007 – in press). Postglacial relative sea-level observations from Ireland and their role in glacial rebound modelling. *Journal of Quaternary Science.*

Bryant, E. A., *et al* (2007). Catastrophic wave erosion, Bristol Channel, United Kingdom: Impact of tsunami? *Journal of Geology*, **115,** 253-269.

Buynevich, I.V., *et al.* (2007). Lithological anomalies in a relict coastal dune: Geophysical and paleoenvironmental markers. *Geophysical Research Letters,* **34,** L09707.

Buynevich, I.V., *et al* (2007). A 1500 yr record of North Atlantic storm activity based on optically dated relict beach scarps. *Geology*, **35,** 543-546.

Cheung, K.F., *et al.* (2007). Numerical modeling and field evidence of coastal overwash in southern New England from Hurricane Bob and implications for paleotempestology. *J. Geophys. Res.* **112,** (F3).

Dawson, A.G., *et al.* (2007). Tsunami deposits in the geological record. *Sed. Geol.,* **200,** 166-183.

Dawson, S. (2007). Diatom biostratigraphy of tsunami deposits: Examples from the 1998 Papua New Guinea tsunami. *Sedimentary Geology*, **200,** 328-335.

De la Vega-Leinert, A. C., *et al.* (2007). Holocene coastal environmental changes on the periphery of an area of glacio-isostatic uplift: an example from Scapa Bay, Orkney, UK. *J. Quat. Sci,* **22,** 755-772.

Engelhart, S.E., *et al.* (2007). Mangrove pollen of Indonesia and its suitability as a sea-level indicator. *Marine Geology,* **242,** 65-81.

Egrin, M., *et al.* (2007). Late Quaternary climate and sea-level changes recorded in sediment composition off the Buyuk Menderes River delta (eastern Aegean Sea, Turkey). *Quaternary International,* **167**, 162-176.

Fletcher, W.J., *et al.* (2007). Palynological evidence for environmental and climatic change in the lower Guadiana valley, Portugal, during the last 13 000 years. *Holocene*, **17,** 481-494.

Gehrels, W.R, *et al.* (2007). Quaternary land–ocean interactions: Sea-level change, sediments and tsunami, *Marine Geology*, **242,** 1-4.

Greene, D.L., *et al.* (2007). Seaward-branching coastal-plain and Piedmont incised-valley systems through multiple sea-level cycles: Late Quaternary examples from Mobile Bay and Mississippi Sound, USA. *Journal of Sedimentary Research,* **77,** 139-158.

Haslett, S.K, *et al.* (2007). Reconnaissance of historic (post-AD 1000) high-energy deposits along the Atlantic coasts of southwest Britain, Ireland and Brittany, France. *Marine Geology,* **242,** 207-220.

Hawkes, A.D., *et al.* (2007). Sediments deposited by the 2004 Indian Ocean Tsunami along the Malaysia-Thailand Peninsula. *Marine Geology,* **242,** 169-190.

Heyvaert, V.M.A., *et al.* (2007). Holocene sedimentary evolution and palaeocoastlines of the Lower Khuzestan plain (southwest Iran*). Marine Geology,* **242**, 83-108.

Hill, J.C., *et al.* (2007). New evidence for high discharge to the Chukchi shelf since the Last Glacial Maximum. *Quaternary Research,* **68**, 271-279.

Hill, T.C.B., *et al.* (2007). Holocene sea-level change in the Severn Estuary, southwest England: a diatom-based sea-level transfer function for macrotidal settings. *Holocene,* **17,** 639-648.

Hori, K., *et al.* (2007). Horizontal and vertical variation of 2004 Indian tsunami deposits: An example of two transects along the western coast of Thailand. *Marine Geology,* **239,** 163-172.

Horton, B.P., *et al.* (2007). The roles of elevation and salinity as primary controls on, living foraminiferal distributions: Cowpen Marsh, Tees Estuary, UK. *Marine Micropal.,* **63,** 169-186.

Horton, B.P., *et al.* (2007). Diatoms from Indonesian mangroves and their suitability as sea-level indicators for tropical environments. *Marine Micropal.,* **63,** 155-168.

Kelletat, D., *et al.* (2007). The SE-Asian mega-tsunami along the west coast of Thailand compared to Holocene paleo-tsunami from the Atlantic region. *Pure, Appl. Geophys.,* **164,** 413-431.

Kennedy, D.M., *et al.* (2007). Reef development at high-latitudes during multiple interglacial cycles: New evidence from Lord Howe Island, southwestern Pacific. *Carbonates and Evaporites,* **22,** 23-32.

Kortekaas, S., *et al.* (2007). Distinguishing tsunami and storm deposits: An example from martinhal, SW Portugal. *Sedimentary Geology*, **200**, 208-221.

Kraft, J.C., *et al.* (2007). The geographies of ancient Ephesus and the Artemision in Anatolia. *Geoarchaeology-an International Journal,* **22,** 121-149.

Mastronuzzi, G., *et al.* (2007). Boulder accumulations produced by the 20th of February, 1743 tsunami along the coast of southeastern Salento (Apulia region, Italy). Marine Geology, **242,** 191-205.

Mattheus, C.R., *et al.* (2007). Control of upstream variables on incised-valley dimension. *Journal of Sedimentary Research,* **77,** 213-224.

Mauz, B., *et al.* (2007). How to reconstruct trends of late Holocene relative sea level: A new approach using tidal flat clastic sediments and optical dating. *Marine Geology,* **237,** 225-237.

McCabe, A.M., *et al.* (2007). Relative sea-level changes from NE Ireland during the last glacial termination. *Journal of the Geological Society,* **164**,1059-1063.

McFadgen, B.G., *et al.* (2007). Tsunamis in the New Zealand archaeological record. *Sed. Geol.* **200,** 263-274.

Moore, A.L., *et al.* (2007). Landward fining from multiple sources in a sand sheet deposited by the 1929 Grand Banks tsunami, Newfoundland. *Sedimentary Geology,* **200,** 336-346.

Morton, R.A., *et al.* (2007). Physical criteria for distinguishing sandy tsunami and storm deposits using modem examples. *Sedimentary Geology,* **200,** 184-207.

Moura, D., *et al.* (2007). Holocene sea level fluctuations and coastal evolution in the central Algarve (southern Portugal). *Marine Geology,* **237,** 127-142.

Narayana, A.C., *et al.* (2007). Tsunami of December 26, 2004 on the southwest coast of India: Post-tsunami geomorphic and sediment characteristics. *Marine Geology,* **242,** 155-168.

Nicholl, S.L., *et al.* (2007). Lagoon subsidence and tsunami on the west coast of New Zealand. *Sedimentary Geology*, **200,** 248-262.

Nunn, P.D. (2007). The AD 1300 event in the Pacific Basin. *Geographical Review,* **97,** 1-23.

Nunn, P.D., *et al.* (2007). Times of plenty, times of less: Last-millennium societal disruption in the pacific basin. *Human Ecology*, **35,** 385-401.

Parham, P.R., *et al.* (2007). Quaternary depositional patterns and sea-level fluctuations, northeastern North Carolina. *Quaternary Research,* **67,** 83-99.

Patterson, R.T., *et al.* (2007). Climate cyclicity in late Holocene anoxic marine sediments from the Seymour-Belize Inlet Complex, British Columbia. *Marine Geology,* **242,** 123-140.

Reeves, J.M., *et al.* (2007). Palaeoenvironmental change in the Gulf of Carpentaria (Australia) since the last interglacial based on Ostracoda. *Palaeo, Palaeo, Palaeo,* **246,** 163-187.

Riveiros, N.V., *et al.* (2007). Modern distribution of salt marsh foraminifera and thecamoebians in the Seymour-Belize Inlet Complex, British Columbia, Canada. *Marine Geology* **242,** 39-63.

Roberts, D.H., *et al.* (2007). Palaeo-ice streaming in the central sector of the British-Irish Ice Sheet during the Last Glacial Maximum: evidence from the northern Irish Sea Basin. *Boreas,* **36**, 115-129.

Ruiz, F., *et al.* (2007). The geological record of a mid-Holocene marine storm in southwestern Spain. *Geobios,* **40,** 689-699.

Scheffers, A., *et al*. (2007). Tsunami deposits on the coastline of west Crete (Greece). *Earth and Planetary Science Letters,* **259,** 613-624.

Scileppi, E., *et al.* (2007). Sedimentary evidence of hurricane strikes in western Long Island, New York. *Geochemistry Geophysics Geosystems* **8**, Q06011,

Selby, K.A., *et al.* (2007). Late Devensian and Holocene relative sea-level changes on the Isle of Skye, Scotland, UK. *Journal of Quaternary Science,* **22**, 119-139.

Simms, A.R., *et al.* (2007). Sea-level history of the Gulf of Mexico since the Last Glacial Maximum with implications for the melting history of the Laurentide Ice Sheet. *Q. Sci. Rev.,* **26,** 920-940.

Tamura, T., *et al.* (2007). Depositional facies and radiocarbon ages of a drill core from the Mekong River

lowland near Phnom Penh, Cambodia: Evidence for tidal sedimentation at the time of Holocene maximum flooding. *Journal of Asian Earth Sciences,* **29,** 585-592.

Tanner, B.R., *et al.* (2007). C3/C4 variations in salt-marsh sediments: an application of compound specific isotopic analysis of lipid biomarkers. *Org. Geochem.,* **38,** 474-484.

Tarasov, L., *et al.* (2007). Coevolution of continental ice cover and permafrost extent over the last glacial-interglacial cycle in North America. *Journal of Geophysical Research-Earth Surface,* **112,** (F2).

Thieler, E.R., *et al.* (2007). A catastrophic meltwater flood event and the formation of the Hudson Shelf Valley. *Palaeogeography Palaeoclimatology Palaeoecology,* **246,** 120-136.

Umitsu, M., *et al.* (2007). Effects of landforms on tsunami flow in the plains of Banda Aceh, Indonesia, and Nam Khem, Thailand. *Marine Geology,* **242,** 141-153.

Vott, A., *et al.* (2007). Holocene palaeogeographies of the eastern Acheloos River delta and the Lagoon of Etoliko (NW Greece). *Journal of Coastal Research,* **23,** 1042-1066.

Whitehouse, P. L., *et al.* (2007). Glacial isostatic adjustment as a control on coastal processes: An example from the Siberian Arctic. *Geology,* **35**, 747-750.

Woodroffe, C.D., *et al.* (2007). Incremental accretion of a sandy reef island over the past 3000 years indicated by component-specific radiocarbon dating. *Geophysical Research Letters,* **34** *L03602.*

Yokoyama, Y., *et al.* (2007). Japan Sea oxygen isotope stratigraphy and global sea-level changes for the last 50,000 years recorded in sediment cores from the Oki Ridge. *Palaeo, Palaeo, Palaeo,* **247,** 5-17.

Yu, S. Y., *et al.* (2007). Evidence for a rapid sea-level rise 7600 yr ago. *Geology,* **35,** 891-894.

Zazo, C., *et al.* (2007). Quaternary marine terraces on Sal Island (Cape Verde archipelago). *Quaternary Science Reviews* **26,** 876-893.

3.7. Activities involving other IGCP projects, UNESCO, IUGS or others: Co-organised meeting planned for IGC Oslo (CGC-05 **Sea level fluctuations: Past, present and future** Willy Fjeldskaar, Lawrence Cathles, Arto Miettenan.

4. Activities planned

4.1. General goals: Deliver comprehensive programme of meetings, start to plan for successor project, begin to consider how to draw project research together for concluding volume.

4.2. Tentative list of specific meetings and field trips: **IGCP495, Fifth International Conference and Field meeting** *Quaternary Land-Ocean Interactions*, Portugal, November 2008, Dr Tomasz Boski (University of the Algarve). Expected delegates = 60, higher developing country representative than Australia 07. **Joint UK IGCP495 Working Group and INQUA Commission on Coastal and Marine Processes, Field trip and Conference** *Holocene Land-Ocean Interactions: Driving Mechanisms and Coastal Responses,* N. Ireland, 22nd – 25th June 2008, organised by Andrew Cooper (University of Ulster). **IGCP495 Palaeotsunami Working Group, Second International Conference and Field Meeting**, Italy and Greece, 23-27th September 2008, organized by Prof. Dr. Mastronuzzi (University of Bari).

5. Project funding requested

We request US$ 5,000 to support attendance at the two International Project Meetings listed in 4.2 above. Any resource will be used to support the attendance of colleagues from less developed countries, with preference given to young scientists.

6. Request for extension, on-extended-term-status, or intention to propose successor project

Preliminary discussions have begun regarding a possible successor project. More details will be provided next year.

7. Financial statement ($ USD only)

See attached appendix.

8. Attach any information you may consider relevant