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| <p><b>Institution:</b><br/>Plymouth University</p>   |
| <p><b>Unit of Assessment:</b><br/>UoA15 General Engineering</p>  |
| <p><b>Title of case study:</b><br/>Coastal erosion and management</p>  |
| <p><b>1. Summary of the impact</b> (indicative maximum 100 words)<br/>The impact described here relates to a specific example of changes in the management of environmental risk for a coastal management study in the UK, and to changes in the dissemination of coastal management knowledge and experience across Europe. The former involved application of formulae developed by the underpinning research to predict sediment transport rates and shoreline evolution. The latter involved development of the Coastal Wiki, an Internet based professional coastal encyclopaedia. This represents a major new tool for dissemination to policy makers, practitioners, researchers and students.</p>  |
| <p><b>2. Underpinning research</b> (indicative maximum 500 words)</p> <p>The work described here comprises those aspects of Professor Chadwick's work, within the Coastal Engineering Group (CERG), now COAST Research Group, which resulted in him leading CERG's contribution to the new analysis of the Slapton Barrier Beach System and leading both UK national and European level networking activities for coastal research and management.</p> <p>Unless otherwise stated, all named individuals were based at Plymouth, at least at the time of the stated contribution.</p> <p>Between 1996 and 1999, Chadwick led field and theoretical studies of longshore transport on shingle beaches, assisted by PhD student Van Wellen. The work involved field studies at Shoreham beach, East Sussex, funded by MAFF. The field work was carried out by a team from Plymouth, Southampton, Brighton and Portsmouth Universities. Subsequently, Chadwick and Van Wellen used the field data together with previous numerical modelling work by Chadwick to develop and test a new algebraic longshore transport equation specifically for shingle beaches. This equation was also compared and assessed against 12 other formulae and found to give better predictions than previous formulae. Between 1998 and 2003 he led a team developing phase resolving numerical models of cross-shore hydrodynamics and morphodynamics, resulting in a new numerical model to predict cross-shore transport on gravel and mixed beaches (PhD student/RF Pedrozo-Acuna, co-investigator Simmonds). In the period 2002- 2003 he was a member of the steering group for the EU funded experiment that produced near full-scale measurements of coarse and mixed sediment beach profile response in the GWK flume in Hannover. This experimental work, with PhD student Pedrozo-Acuna, was used to test and validate the numerical model mentioned above. In 2002-2004 Chadwick, assisted by Research Fellow Karunarathna, led a research team investigating coastal processes for the Slapton Barrier Beach System (under sub-contract from Scott Wilson Ltd), a major UK barrier beach system. This study led to the development of a new coastal management plan for this major barrier beach system, for the next 50 years. Between 2001 and 2005 Chadwick led the formation and operation of the UK Coastal Zone Network, COZONE, to provide a forum through which the coastal community could address issues raised by both the research community and practitioners. Since the completion of EPSRC funding COZONE has continued to be run by CERG. In 2006, COZONE was linked to 12 other national networks across Europe through the European Network for Coastal Research Co-ordination Action (ENCORA). From 06 to 09 Chadwick led the UK contribution to the European Network for Coastal Research Co-ordination Action (ENCORA) (RA Jackson, co-investigator Simmonds) and was the ENCORA themes co-ordinator and led co-ordination of the overall development of the Coastal Wiki.</p> |
| <p><b>3. References to the research</b> (indicative maximum of six references)</p> <p>The indicative references have been published in <i>Coastal Engineering</i>, the leading European journal for research in this subject, in <i>Maritime Engineering</i>, the Institution of Civil Engineers journal</p>   |

which has a wide international readership of professional engineers and the *International conference on Coastal Engineering*, the leading international conference in this subject. The three best papers (in order) follow and the additional conference paper is included to show that dissemination has taken place to an international audience. The number of citations to each paper is included to attest to their quality being of at least 2\*

1. Van Wellen, E, **Chadwick, A J** and Mason, T. (2000). A review and assessment of longshore sediment transport equations for coarse grained beaches. *Coastal Engineering*, 40, 3, 243-275. (67 citations). DOI: 10.1016/S0378-3839(00)00031-4
2. Pedrozo, A., **Simmonds, D.J.**, Otta, A.K., and **Chadwick, A.J.** (2006). On the cross-shore profile change of gravel beaches. *Coastal Engineering*, 53 (4), 335-347. (51 citations). DOI: 10.1016/j.coastaleng.2005.10.019
3. **Chadwick, A. J.**, Karunaratna, H., Gehrels, R, Massey, A. C., O'Brien, D., and Dales, D.(2005). A New Analysis of the Slapton Barrier Beach System. *Maritime Engineering* 158, 4, 147-161 (17 citations)
4. Dronkers, J., **Chadwick, A. J.**, Jackson, J. E., and Villars, M. (2008) 'Sharing Coastal Knowledge Within Europe: ENCORA and the Coastal WIKI'. *International conference on Coastal Engineering 2008*.

**Supporting GRANTS AND CONTRACTS for Chadwick as PI:** 1996-1999 MAFF Shingle Beach Field Research Project, £60600; 1998-2001 EPSRC Numerical modelling and field validation of the cross-shore profile development of coarse grained beaches, £102,559; 2002-2003; 2002-2005 EPSRC Beach Processes Network, £86,000; 2006-2009 EU, FP6, Network of Excellence, European Network for Coastal Research Co-ordination Action (ENCORA), €254,000.

#### 4. Details of the impact (indicative maximum 750 words)

The research has generated impact on coastal management policies through (1) direct involvement and incorporation into a coastal management plan and (2) the creation of a dissemination mechanism that has informed the work of scientists, policymakers and practitioners involved in coastal management.

Slapton Sands is recognised for its nature conservation and landscape importance. The beach is ~5Km long and an arterial road, of major significance to the local population and economy, runs across the top of the shingle ridge. During a series of storms in the winter of 2000/01, significant damage occurred to the barrier beach and a 250m section of the road. This prompted public and media outcry resulting in the formation of the Slapton Line Partnership (SLP) and commissioning of the comprehensive evaluation of the issues relating to coastal processes. The primary purpose of the study was to determine an appropriate future shoreline management response. This study was carried out by Scott Wilson Ltd (since taken over by URS Infrastructure & Environment UK Limited) in collaboration with the University of Plymouth and Atlantic Consultants.

As a direct result of Chadwick's work on the **Slapton Coastal Zone Management Study** [Source 5.1] the SLP enacted a long-term management strategy and associated adaptation strategy/activities with the local community. Due to the study the SLP were able to secure a £245,000 DEFRA "pathfinder" grant (through the Flood and Coastal Erosion Risk Management Programme) to take the adaptation programme forward. As a result of these activities public surveys showed that by 2010 "*there was a broader spread of support for the managed realignment policy (around 80% very or fairly supportive) ... increased levels of awareness about the future of the road and policies associated with it...[and]...an increase in those considering that their views were being taken into account, up by 11%*". [5.2]

During the study Chadwick applied one-line shoreline evolution modelling for the first time to Slapton Sands which represented a significant step forward in understanding its contemporary morphological evolution. Shoreline movement between 1999 and 2003 was modelled using the model developed by CERG (Chadwick and Van Wellen longshore sediment transport formula). The study concluded that although the risk of a breach of the shingle bank will remain low over

the next 30-50 years, future sea-level rise and increased storminess will increase the rate of erosion and the risk of a major recession event. With no intervention measures, it was anticipated that the barrier beach will eventually be breached forming tidal inlets. Throughout the study Chadwick assisted in communicating the findings fully thorough discussions with the SLP Steering Group, Slapton Village Council reps and local interest groups and to the general public at the exhibition of project findings.

URS's Director of Water Resources, Flood & Coastal, [5.3] quantified the project as costing the company £200k to conduct but worth much more in terms of demonstrating their commercial competence and continual improvement. He financially quantifies the Plymouth contribution as 20%, but deems this a poor representation of the true value to the study and company as the wave and sediment modelling for shingle beaches was "*at the heart of the issue*" so was of pivotal importance both to the success of the project and of the future management of the Slapton Line. Working with Chadwick and others at Plymouth, has enabled URS to win subsequent contracts via their improved technical excellence [5.3].

Meanwhile for the local community and wildlife the study has had significant implications. The Manager of the South Devon's Area of Outstanding Natural Beauty [5.4] described the study as being vital in providing a publicly accountable 'expert' recommendation to the SLP of a robust long-term management strategy. The Coastal Adaptation: Community Involvement Toolkit V4 [5.2] states: "*Politically it was key that the policy should be formed from expert and independent sources in a transparent manner in order for the recommendations to have a chance of being accepted by the local community.*" As a direct result of the study the SLP management plan (funded by the £245k DEFRA grant) allowed for public/business communication and adaption, habitat adaption, the promotion of environmental tourism and re-routing of vital transport links: "*A report looking at all the issues concluded that the best way forward to preserve the natural features of the area and prolong the life of the road was to plan for moving the most vulnerable sections inland as well as maintaining strategically placed mounds of shingle. In this way we believe the road will be kept operating for at least 25 further years.*" [5.6] The chairing partner of the Slapton Line Partnership [5.7] said that the study was "*a great piece of work, really effective*" and "*acted as a catalyst to bring create an alliance amongst the key partners resulting in incredibly positive feedback from local businesses, positive engagement from the local Parish Councils and a positive turnaround in local community views*".

The successful work in Slapton Sands established the value of the underlying model and its more general applicability. In order to develop this, Chadwick has been instrumental in the sharing of coastal knowledge and experience among researchers, practitioners and policy makers, at a European level with wider global interest. Chadwick coordinated (2006-2009) the work package responsible for creating the Coastal Wiki and for elaborating the Coastal Action Plan as part of the ENCORA [5.8] networking project (EU 6<sup>th</sup> Framework Programme Coordination Action). ENCORA facilitated sharing of coastal knowledge and experience among researchers, practitioners and policy makers, to produce a European wide knowledge base and to make recommendations for critical future research for coastal zone management.

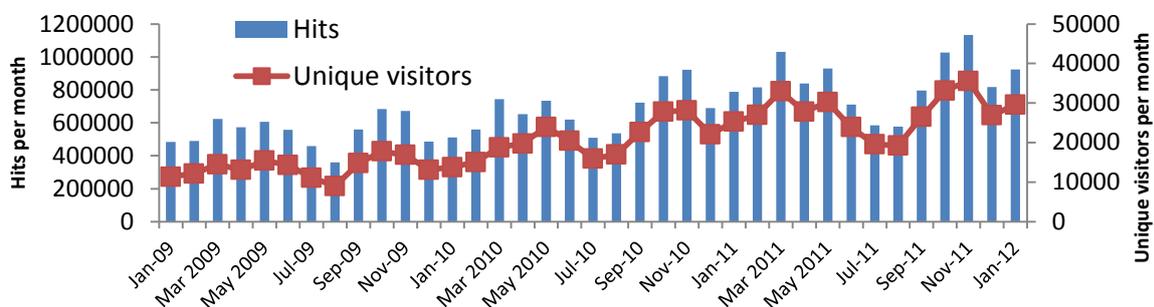
Under Chadwick's coordination "*the Coastal Action Plan was developed in 2008 during a series of workshops with >100 European coastal and marine experts. It contributed to the development of the concept of coastal observatories and it strongly advocated a concerted European implementation strategy. The plan was presented to national and European funding agencies. It was directly endorsed by the German research funding agency, who provided funding for a German coastal observatory network. The European Commission incorporated the coastal observatory concept in the GMES programme and in the GEO programme, which continues in the EU 2014-2020 programme.*" Retired advisor - coastal and marine management and coastal dynamics (Deltares) [5.5]

An additional output produced under Chadwick's coordination was the **Coastal Wiki** [5.9], a professional internet encyclopaedia (written with both non-experts (policy makers, general

public) and experts (scientific stakeholders, practitioners) in mind, that guarantees high quality information which highlights relationships, reveals contexts, enhances feedback and guides users in a simple and natural way through related topics. The wiki connects disparate knowledge sources and provides up-to-date, coherent, reliable and comprehensive information. In September 2013 it contained ~1858 articles and is continuously updated by authorised expert users. The main page has been visited over 270,000 times (Feb 2012) and the total number of hits to the web site reached over 1 million per month by March 2011.

HR Wallingford's Technical Director [5.10] took part in the ENCORA project and also read/authored articles from the coastal wiki. He states that ENCORA was helpful for networking, particularly for enabling him to meet leading European researchers with whom he had not interacted previously and also that the coastal wiki enabled him to form new ideas which since 2009 have been taken forward in HR Wallingford's projects (HR Wallingford's income is made up of 15% research income (mainly RCUK) and 85% consultancy activities).

The Coastal Wiki [5.9] is a valuable resource for all those engaged in coastal engineering and management. Hits have steadily increased since it was first launched:



Deltares retired coast/marine adviser [5.6] stated that *“the Coastal Wiki has become a major information source for coastal professionals - managers, practitioners, consultants, students. It provides information on coastal and marine governance issues, it provides good practice examples and it explains technical issues relevant for coastal and marine management. There are more than a million hits each month from users worldwide. The Coastal Wiki is recommended as a general information source for coastal managers on the websites of the European Commission and DEFRA. It is largely self-maintaining; it has developed after ENCORA without any external funding. Both the number of authorized contributors and the number of users are steadily increasing. At present, an international editorial board of outstanding experts is reviewing the entire content - more than thousand articles- in order to ensure the highest quality and reliability. Chadwick is one of the editorial board members.”* [5.6]

##### 5. Sources to corroborate the impact (indicative maximum of 10 references)

[5.1] Original Scott Wilson report

[5.2] Coastal Adaptation: Community Engagement Toolkit V4, Alan Denbigh, SLP, July 2011.

[5.3] Interview summary with Director, Water Resources, Flood & Coastal, URS Infrastructure & Environment UK Limited, Scott House, Alencon Link, Basingstoke, Hampshire, RG21 7PP,

[5.4] Interview summary with the South Devon AONB Manager, Follaton House, Plymouth Rd, Totnes, Devon, TQ9 5NE, 01803 861142, [www.southdevonaonb.org.uk](http://www.southdevonaonb.org.uk)

[5.5] Slapton Line Partnership public documents: Web Site: <http://www.slaptonline.org/>  
Executive summary of study: Slapton\_Executive\_Summary\_Report\_August\_06.pdf

[5.6] Interview summary with with a self-employed coast and sea expert and retired advisor coastal and marine management and coastal dynamics (Deltares): 0031651232406

[5.7] Corporate Director, South Hams District Council,

[5.8] ENCORA Portal:

[http://www.coastalwiki.org/index.php?option=com\\_content&task=blogcategory&id=1&Itemid=82](http://www.coastalwiki.org/index.php?option=com_content&task=blogcategory&id=1&Itemid=82)

[5.9] Coastal Wiki: [http://www.coastalwiki.org/coastalwiki/Main\\_Page](http://www.coastalwiki.org/coastalwiki/Main_Page)

[5.10] Interview summary with Technical Director, HR Wallingford Limited, Wallingford, Oxfordshire, OX10 8BA.