Observation du trait de côte SOERE DYnamique MOrphosédimentaire et VULnérabilité (SO-DYMOVUL)

Laboratoire LETG-Brest-Géomer UMR 6554 CNRS



Laboratoire Domaines Océaniques
UMR 6538 CNRS











En 2010 création d'un Système d'Observation et d'Expérimentation à long terme pour la Recherche en Environnement (SOERE) — Ministère de l'Enseignement Supérieur et Recherche / Direction Générale Recherche et Innovation ⇒ réseau d'observation multi-sites et intégré sur les trois façades littorales métropolitaines :

- Manche Université de Caen : SO-DYC « DYnamique du trait de Côte »
- Bretagne UBO-IUEM : SO-DYMOVUL « DYnamique MOrphosédimentaire et VULnérabilité »
- Méditerranée Université de Montpellier (OSU OREME) : SO-LTC
 « Littoral Trait de Côte »

SO-DYMOVUL comprend un volet <u>observation du trait de côte</u> = SOERE « trait de côte » ⇒ reprend une partie des observations du trait de côte réalisées dans le cadre de l'ODC-IUEM (*Observatoire du Domaine Côtier de l'Institut Universitaire Européen de la Mer*) lancé en 2002, à l'échelle de la Bretagne

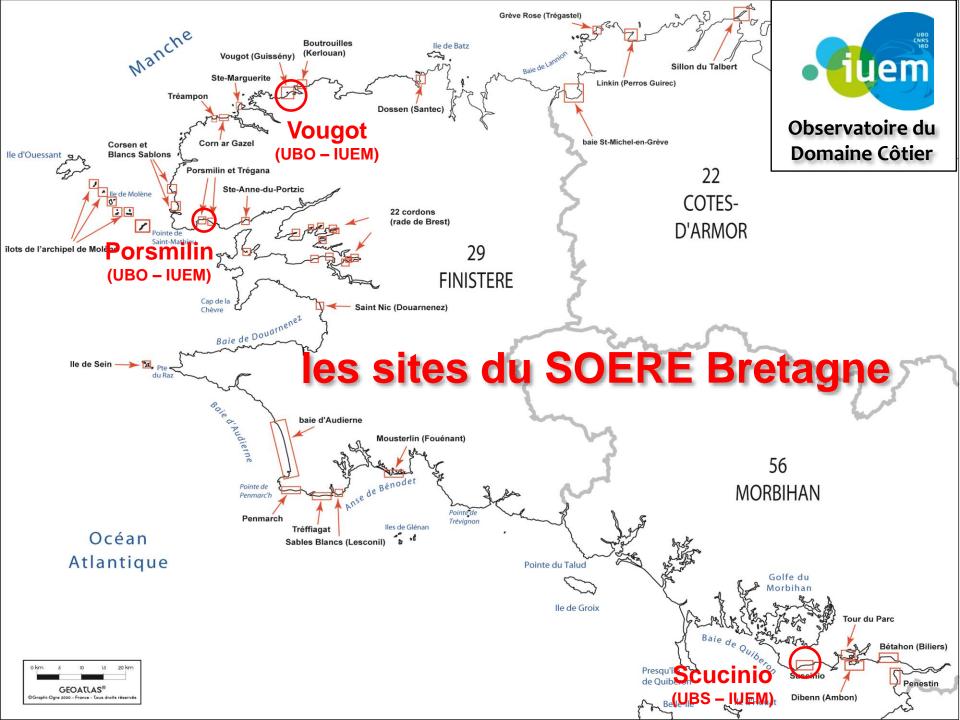
Depuis 2012 le SOERE « trait de côte » a été étendu aux 4 OSU de Nantes, Bordeaux, Aix-Marseille, Réunion (+ Brest, Caen, et Montpellier) ⇒ l'IUEM en assure la présidence pour 2013 et 2014

D'ici fin 2013, vers une labellisation de la série d'observation « trait de côte » du SO-DYMOVUL par l'INSU (Institut National des Sciences de l'Univers)

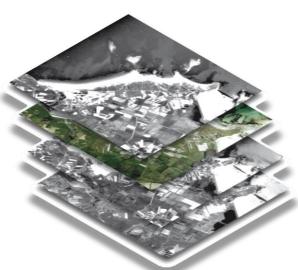
Objectifs du SOERE « trait de côte »

<u>approche fondamentale</u> = décrypter le signal du changement des conditions météo-marines au travers des dynamiques morpho-sédimentaires + analyse des processus morphodynamiques

<u>approche appliquée</u> = élaboration d'une série d'observation à long terme pour aider les politiques de gestion et d'aménagement de la zone littorale



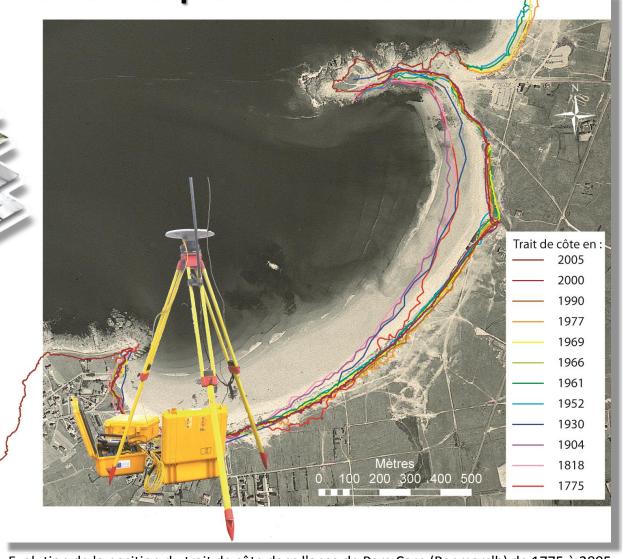
Suivi de la cinématique du trait de côte



traitement de photos aériennes et cartes anciennes

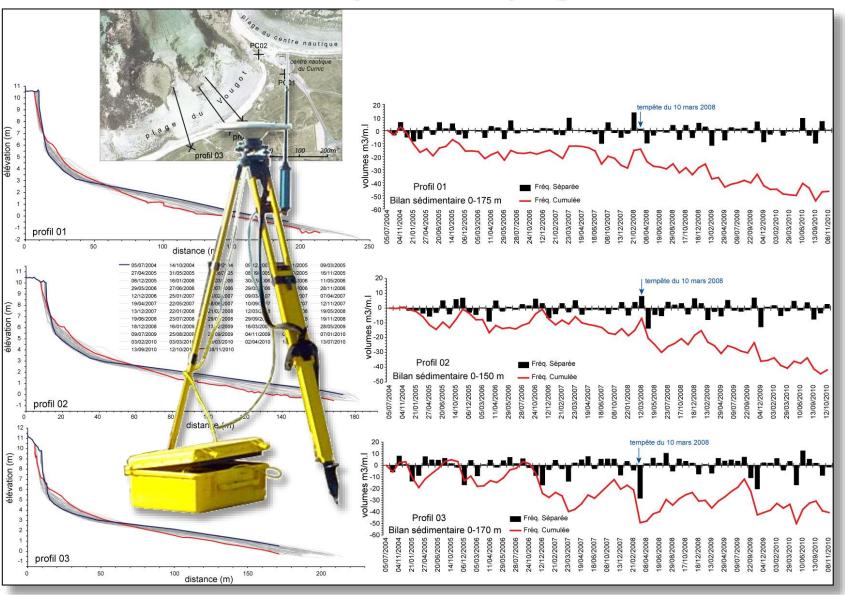
et/ou

mesures de terrain au DGPS



Evolution de la position du trait de côte dans l'anse de Pors-Carn (Penmarc'h) de 1775 à 2005 Source : A. Hénaff

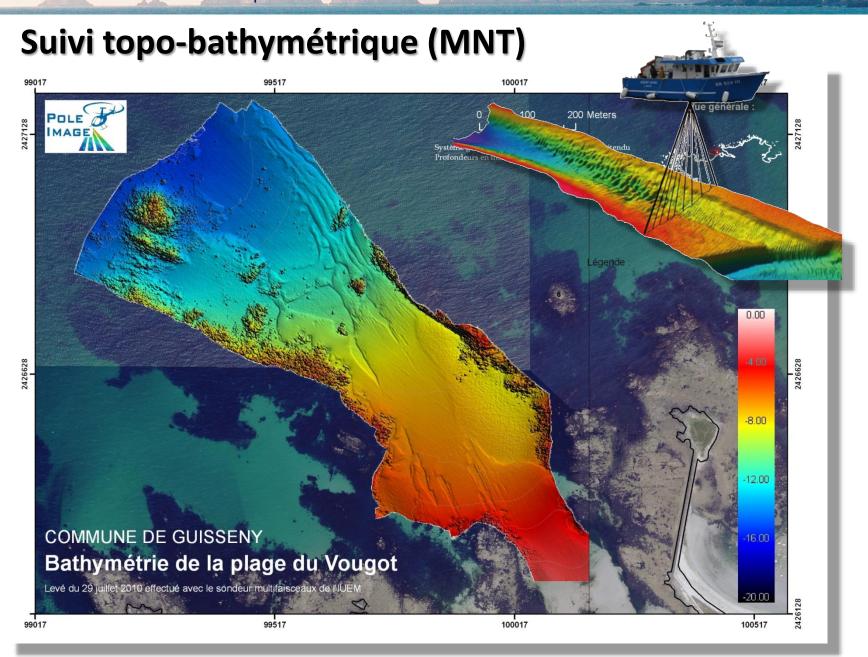
Suivi de profils de plage



Suivi de plage en 3D (MNT)



Drone / Laser : plage de Porsmilin (source : LDO)



Suivi topo-relief (3D) – drone / optique



Valorisation

Marine Geology 283 (2011) 36-55



Contents lists available at ScienceDirect

Marine Geology

journal homepage: www.elsevier.com/locate/margeo



Quarrying, transport and deposition of cliff-top storm deposits during extreme events: Banneg Island, Brittany

Bernard Fichaut*, Serge Suanez

Geomer, UMR 6554 CNRS LETG, IUEM, Place Nicolas Copernic, Technopole Brest-Iroise, Plouzane, 29280, France

ARTICLE INFO

Article history:
Received 11 February 2010
Received in revised form 5 November 2010
Accepted 9 November 2010
Available online 4 December 2010

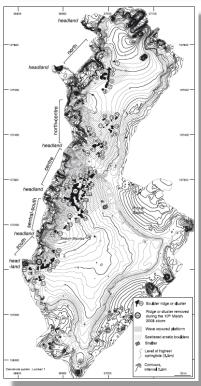
Keywords: island Brittany cliff-top storm deposits storm Eastern-Atlantic

ABSTRACT

On 10 March 2008, a particularly high energy storm hit the French Atlantic coast and the western part of the English Channel. This storm did not generate exceptionally high waves: significant and maximum wave heights recorded in the Iroise Sea (Brittany) reached 10.85 and 18.17 m respectively, whereas during the 1989-90 winter storms, they had reached 12 and 20 m, respectively. The exceptional character of the March 2008 storm event arises from the fact that it occurred during an exceptional spring tide. From a morphogenetic point of view, the effects of this storm in terms of block quarrying, transport and deposition on Banneg Island (Brittany) were significant. This study shows that the weight of the blocks displaced during the event was between 0.07 and 42.64 t, with a median value of 0.72 t. More than 60% of the blocks were quarried from the wave-scoured cliff-top platform, demonstrating that the favoured zone for supplying material was located inland of the cliff. Two dominant modes of transport were involved depending on the relationship between extreme water levels and cliff height. At the centre of the island, the height of the waves breaking over the top of the cliffs on the western coast resulted in a torrential surge that flowed out towards the eastern coast of the island over a landward-sloping platform. On the western coast of the island, blocks weighing between 0.3 and 1.4 t were displaced between 50 and 90 m from the cliff edge by this flow. At the flow outlet on the eastern coast (90 m from the western cliff edge), a pit 1.6 m deep was excavated at Porz ar Bagou cove and some of the mobilised blocks were deposited in two parallel lobes about 40 m seaward of the eastern shoreline. Elsewhere on the island, block transport occurred by airborne projection although wave heights were lower than the altitude of the cliffs. The pressure exerted by breaking waves on the bedrock was sufficient to quarry and displace blocks. A temporal comparison of the changes recorded in the double and triple boulder ridges showed that the most seaward ridges were practically untouched with the most important changes occurring in the second and third ridges. These observations allow us to propose a spatiotemporal model for the accretion of cliff-top storm deposits (CTSDs), with the various stages of CTSD formation being directly related to the morphological evolution of the cliff.

© 2011 Published by Elsevier B.V.



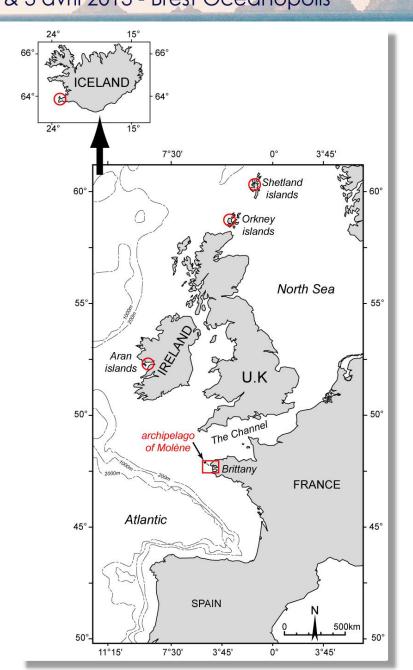


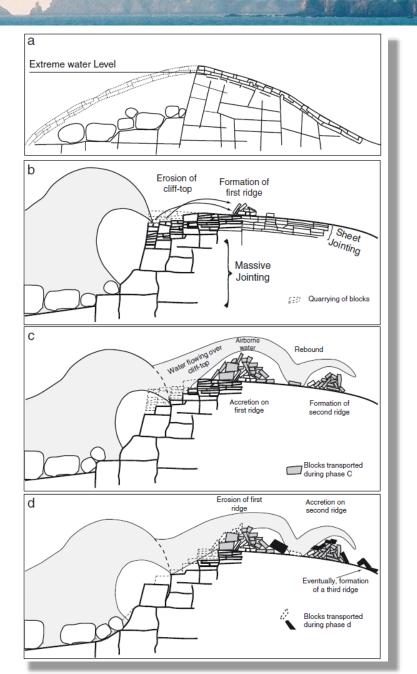


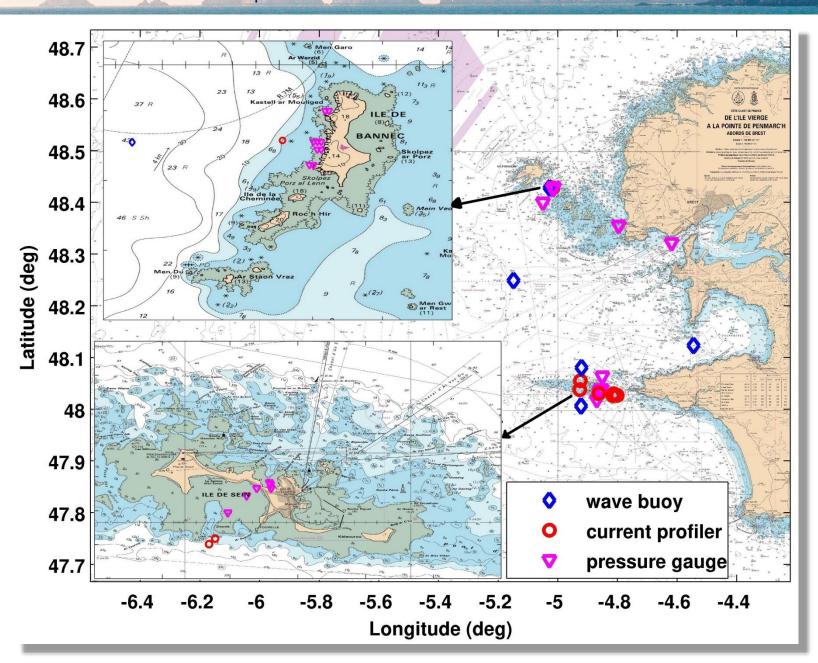
Île de Banneg (archipel de Molène) – Fichaut et Suanez, 2011



Île de Banneg (archipel de Molène) – Fichaut et Suanez, 2011







Valorisation

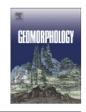
Geomorphology 139-140 (2012) 16-33



Contents lists available at SciVerse ScienceDirect

Geomorphology

journal homepage: www.elsevier.com/locate/geomorph











Review

Dune recovery after storm erosion on a high-energy beach: Vougot Beach, Brittany (France)

Serge Suanez a,*, Jean-Marie Cariolet a, Romain Cancouët b, Fabrice Ardhuin c, Christophe Delacourt b

- a GEOMER UMR 6554 CNRS LETG, Institut Universitaire Européen de la Mer, Place Nicolas Copernic, 29280 Plouzané, France
- b Domaines Océaniques, DO UMR 6538 CNRS, Institut Universitaire Européen de la Mer, Place Nicolas Copernic, 29280 Plouzané, France
- c IFREMER, Laboratoire d'Océanographie Spatiale, BP70, 29280 Plouzané, France

ARTICLE INFO

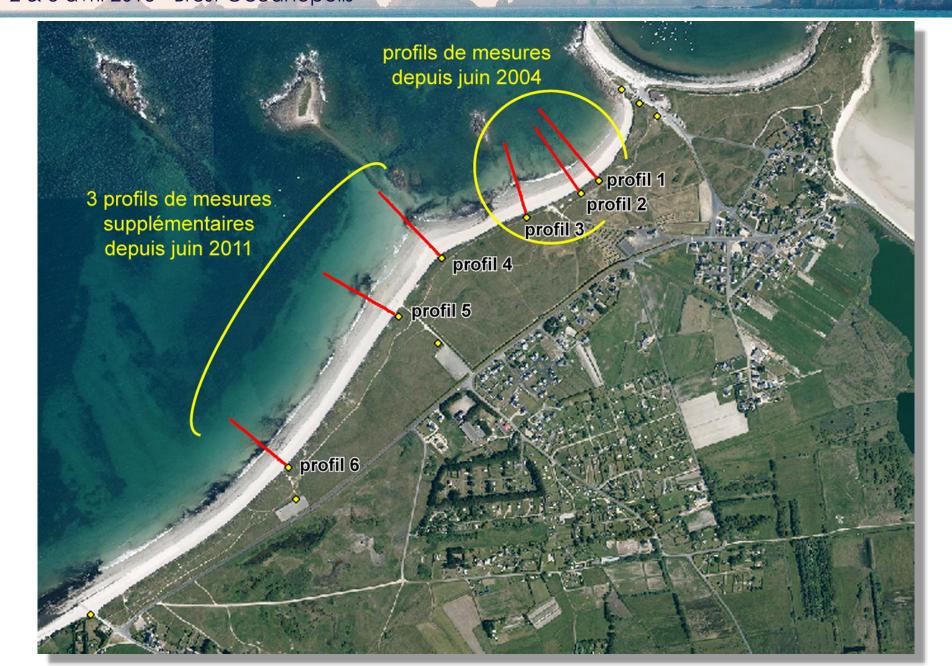
Article history: Received 21 March 2011 Received in revised form 8 October 2011 Accepted 10 October 2011 Available online 23 October 2011

Keywords:
Coastal dune
Dune recovery
Dune toe accretion
Dune crest retreat
Storm surge
Extreme water levels
Accomodation space

ABSTRACT

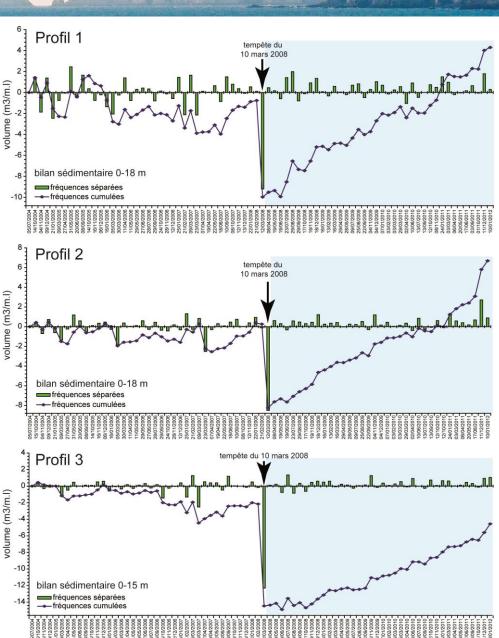
On 10th March 2008, the high energy storm Johanna hit the French Atlantic coast, generating severe dune erosion on Vougot Beach (Brittany, France). In this paper, the recovery of the dune of Vougot Beach is analysed through a survey of morphological changes and hydrodynamic conditions. Data collection focused on the period immediately following storm Johanna until July 2010, i.e. over two and a half years. Results showed that the dune retreated by a maximum of almost 6 m where storm surge and wave attack were the most energetic. Dune retreat led to the creation of accommodation space for the storage of sediment by widening and elevating space between the pre- and post-storm dune toe, and reducing impacts of the storm surge. Dune recovery started in the month following the storm event and is still ongoing. It is characterised by the construction of "secondary" embryo dunes, which recovered at an average rate of 4-4.5 cm per month, although average monthly volume changes varied from -1 to 2 m3.m-1. These embryo dunes accreted due to a large aeolian sand supply from the upper tidal beach to the existing foredune. These dune-construction processes were facilitated by growth of vegetation on low-profile embryo dunes promoting backshore accretion. After more than two years of survey, the sediment budget of the beach/dune system showed that more than 10,000 m3 has been lost by the upper tidal beach. We suggest that seaward return currents generated during the storm of 10th March 2008 are responsible for offshore sediment transport. Reconstitution of the equilibrium beach profile following the storm event may therefore have generated cross-shore sediment redistribution inducing net erosion in the tidal zone.

© 2011 Elsevier B.V. All rights reserved.





Plage du Vougot (Guissény) – Suanez et al., 2012



Valorisation

Long-term morphodynamic evolution of the Sillon de Talbert gravel barrier spit, Brittany, France

Pierre Stéphan

Laboratoire de Géographie Physique - UMR 8591 CNRS, Universités Paris 1 Panthéon Sorbonne et Paris 12 1 Place Aristide Briand, 92195 Meudon cedex, France Stephan.pierre00@gmail.com

Serge Suanez and Bernard Fichaut

LETG-Géomer-Brest, UMR 6554 CNRS, Institut Universitaire Européen de la Mer, Université de Brest, Technopôle Brest-Iroise, Place Nicolas Copernic, 29280 Plouzané, France

ABSTRACT

The Sillon de Talbert is the largest gravel barrier spit in Brittany and forms a swash-aligned formation exposed to swell that enters the English Channel from the west. It partially protects the islands of the Bréhat Archipelago against coastal erosion and marine flooding of low-lying land. The main morphological changes to the Sillon de Talbert have been studied since the 17th century, and were accurately quantified between 1930 and 2010, based on early marine maps, aerial photographs and topographic surveys recently conducted by DGPS. The examination of early maps shows this barrier was attached to the Olone Islands until the end of the 17th century. Towards the mid-18th century, a breach that had formed in the north of the barrier resulted in its transformation into a trailing spit. A gradual change in its general direction towards a more driftaligned position promoted longshore sediment drift towards the distal end. A slow cannibalization processes began, dividing the spit into a source area at the proximal section, a transit zone in the median section and an accumulation zone at the distal section of the spit. Long-term analysis of shoreline changes over the past decades highlights the mobility of the Sillon de Talbert, which is characterized by rapid landward retreat by rollover. This trend is mainly due to a sediment supply deficit, which can be explained above all by sediment depletion on the continental shelf and, to a lesser extent, by anthropogenic activities, particularly gravel extraction. The results obtained show that for the entire period (1930-2010), the mean migra-

tion rate was 1.1 m/yr. Upon closer investigation, the rate of retreat and the main morphological changes proves to differ between the morphosedimentary units of the spit and illustrates cannibalization processes. Thus, the proximal section shows very high retreat rates (1.35 m/yr) due to a sediment budget deficit, which can be explained by gravel migration towards the north-east section of the spit. For these sections, this evolution results in greater sensitivity to erosion and breaching during severe storms, as was the case in April 1962 and during winter 1989-90. Its median section corresponding to the transit zone shows lower retreat rates than the proximal section (1.05 m/ vr) and a relatively balanced sediment budget, as illustrated by the high resilience of this section of the spit submitted to sluicing overwash. Finally, the distal section has undergone retreat by rollover of its exposed outer face and progradation of its inner face which benefited from sediment supply from proximal section. From the 1970s, several human interventions based on coastal defense strategy attempted to slow the spit's retreat due to rollover. The failure of these interventions led to the definition of a new coastal management policy. Since the 2000s, the national organization in charge of the acquisition of coastal land for its preservation (Conservatoire du Littoral) has been implementing an acquisition policy geared towards urbanized areas sensitive to coastal erosion and marine flooding in the back-barrier area of the Sillon de Talbert. This policy enables the organization of strategic withdrawal and leaves

ADDITIONAL KEYWORDS: Brittany, France; coastal morphology; barrier spit evolution.

Manuscript submitted 19 December 2011, revised and accepted 9 January 2012.

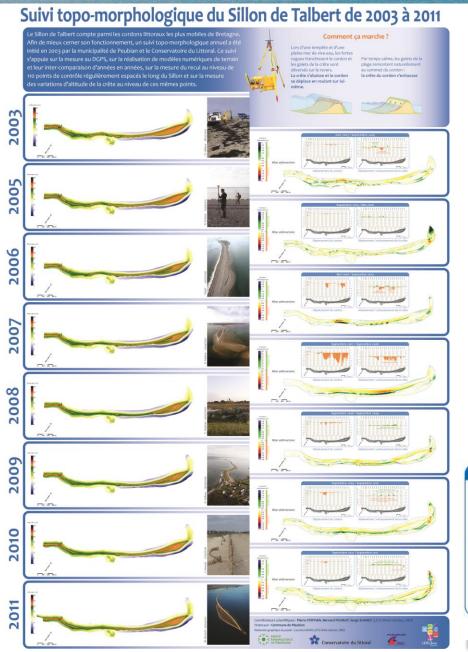
≺ ravel spits generally have a high mobility potential (Carter et al. 1989; Héquette and Ruz 1991; Forbes et al. 1991, 1995; Fox et al. 1995; Jolicoeur et al. 2010; Stéphan 2011a, 2011b). Landward retreat by rollover is caused by overwash (Carter and Orford 1984). The morphological impact of overwashing is determined by (i) storm frequency and intensity, (ii) the joint oc-

of an eroding proximal source area, a

natural processes to gradually take their course. currence of such storms and high spring tides on macro-tidal coasts, (iii) the sediment budget of the spit and its inertia (volume and height), as defined by Orford and Carter (1984). A cannibalistic trend is also observed when sediment input is lower than sediment removed by longshore drift. In this case, the cannibalistic process leads to the gradual appearance



Valorisation



Comment ça marche?

Lors d'une tempête et d'une pleine mer de vive-eau, les fortes vagues franchissent le cordon et les galets de la crête sont déversés sur le revers.

La crête s'abaisse et le cordon se déplace en roulant sur luimême. Par temps calme, les galets de la plage remontent naturellement au sommet du cordon :

la crête du cordon s'exhausse





Déplacement du cordon

Abaissement / exhaussement de la crête

Valorisation

Effects of natural and human forcing on mesoscale shoreline dynamics of Saint-Michel-en-Grève Bay (Brittany, France)

Rv

Serge Suanez and Pierre Stéphan

GEOMER – UMR 6554 CNRS LETG, Université de Bretagne Occidentale Institut Universitaire Européen de la Mer, Technopôle Brest-Iroise Place Nicolas Copernic, 29280 Plouzané, France

serge.suanez@univ-brest.fr

ABSTRACT

By monitoring shoreline changes and subaerial beach volume in Saint-Michel-en-Grève bay in northern Brittany over the past 20 years, the mesoscale shoreline dynamics were assessed. Previous work has shown that both natural and human forcing have played an important role in the long-term changes of the bay, but the respective causes of each type of forcing have not previously been studied in detail. This study shows that between 1990 and 2009, a large volume of sediment input resulted in rapid accretion of dunes in the bay. Sedimentation rates reached an average of $0.1 \,\mathrm{m}^3/\mathrm{m}^2/\mathrm{yr}$ over the whole study period. This positive sediment budget confirms the trend of sediment accumulation noted since the end of the 19th century. Nevertheless, temporal variation in the shoreline dynamics can be related to changes in the frequency and magnitude of storm surges and resulting high tides. Shoreline erosion/accretion records dating from 1990 were compared with extreme water levels. Relatively high shoreline retreat rates during periods of 1999-2002 and 2006-2008 were associated with a relatively large number of storm surges. Slower erosion and relatively

rapid accretion occu more recent period, v storm surges. Erosic of extreme spring his storms. Storms and s associated with Atla of movement have a energy and the heigh Saint-Michel-en-Grè erosion/accretion cha Atlantic Oscillation low water level play accretion processes. back processes due t hydrodynamic condi coastal engineering w to eliminate the conf sediment transport in Rocher, while the re the dune of Tréduder

horeline dynamics are always difficult to determine precisely because the processes by which shores accrete or erode frequently result from a combination of natural and anthropogenic forcing. For instance, erosion on a popular tourist beach at St. Queen's Bay in Jersey (Channel Islands) has been associated with natural forcing via the cessation of sediment input from finite offshore sources as well as with anthropogenic forcing via construction of a seawall and mining of beach sand that has exacerbated erosion (Cooper and Pethick 2005). Similarly, shoreline change analysis carried out along the California coast showed that 40% of beaches are undergoing long-term erosion even if a long-term accretional signal in some parts of the state is probably related to coastal engineering projects and/or large sediment input from rivers (Hapke et al. 2009). Morphological dune and beach monitoring at Cabo Falso (Baja

ADDITIONAL KEYWORDS:

Sediment budget, monitoring; shoreline changes; dune erosion, storm surges, human forcing.

Manuscript submitted 2 June 2010, revised and accepted 8 February 2011

Califomia peninsula) also showed morphodynamic processes were the response to natural, Hurricane Juliette (2001), and anthropogenic influence (Camacho-Valdéz et al. 2008). Several case studies shown anthropogenic activity was the most influential factor in the long-term sediment budget and shoreline dynamic, making very complex the evaluation of natural forcing on these morphological changes (Lorenzo et al. 2007; Martinez del Pozo and Anfuso 2008; Pandian et al. 2004; Anthony and Dolique 2001).

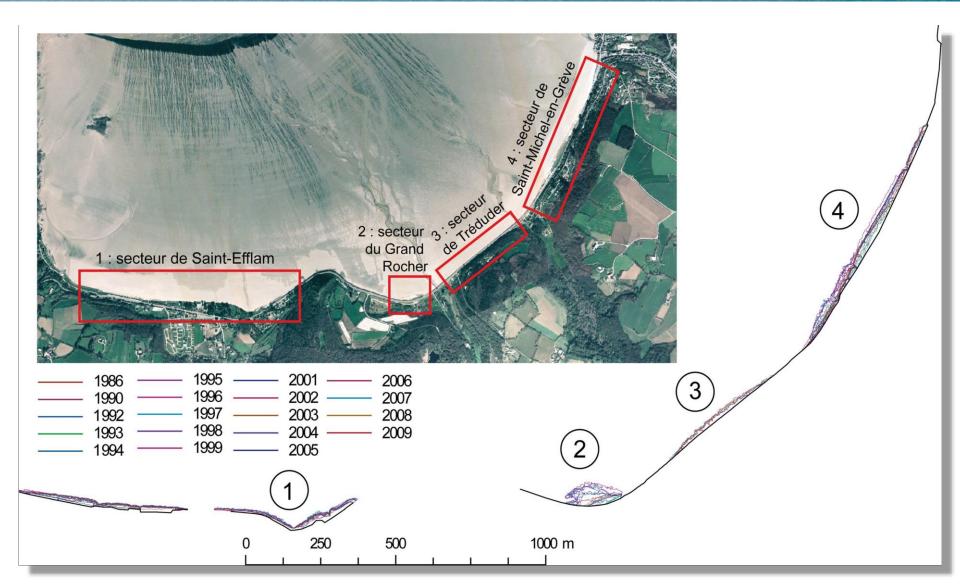
In this study, we analyzed the respective roles of natural and anthropogenic



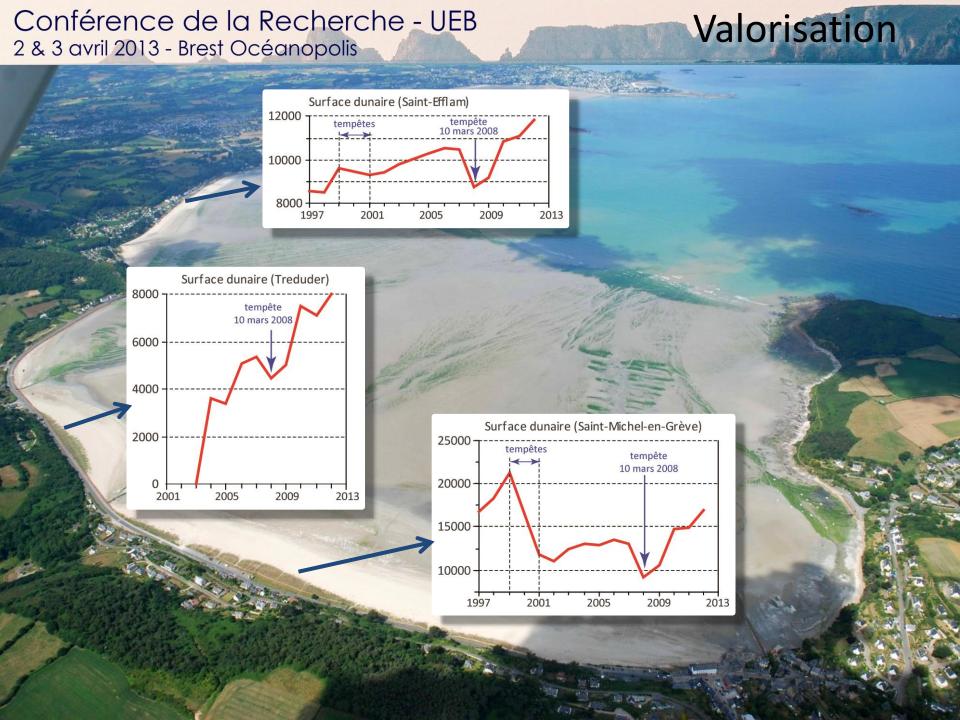
Baie de Saint-Michel-en-Grève - Suanez et Stéphan, 2011

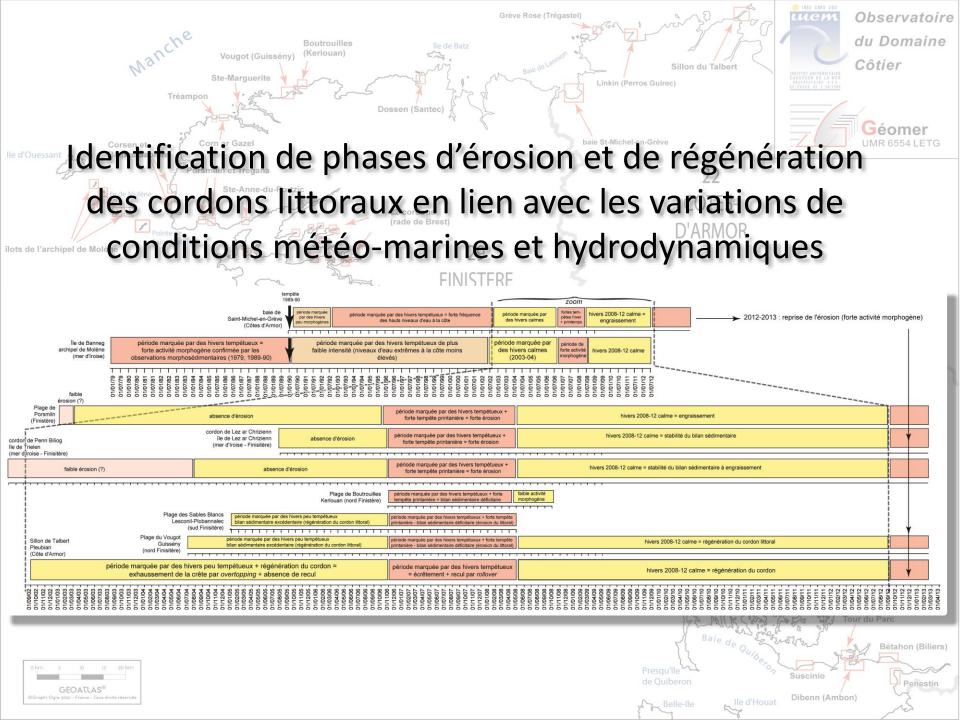
Shore & Beach ■ Vol. 79, No. 2 ■ Spring 2011

Page 19



Baie de Saint-Michel-en-Grève – Suanez et Stéphan, 2011





Valorisation

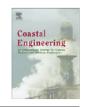
Coastal Engineering 74 (2013) 11-18



Contents lists available at SciVerse ScienceDirect

Coastal Engineering

journal homepage: www.elsevier.com/locate/coastaleng





Runup estimations on a macrotidal sandy beach

J.-M. Cariolet ^{a,b,*}, S. Suanez ^a

- a GEOMER, UMR 6554 CNRS LETG, Institut Universitaire Européen de la Mer, Technopôle Brest-Iroise, Place Nicolas Copernic, 29285 Plouzané, France
- ^b Department of Geography, University of Leicester, University Road, Leicester LE1 7RH, United Kingdom

ARTICLE INFO

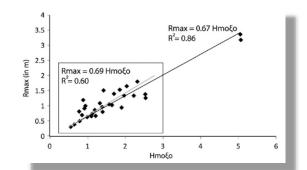
Article history:
Received 14 August 2012
Received in revised form 8 November 2012
Accepted 20 November 2012
Available online 30 December 2012

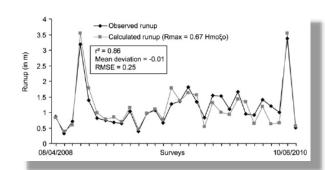
Keywords: Runup Morphodynamic Beach slope High-tide deposit Macrotidal environment Extreme water level

ABSTRACT

This paper presents a methodological approach to calculate runup from the analysis of morphodynamic conditions on a macrotidal sandy beach. The method is based on measurements of the elevation of high-tide deposits and on the analysis of morphological and hydrodynamic changes. A series of measurements has been carried out on the beach of Vougot (Brittany, France) under different wave conditions. This allowed to assess runup formula effectiveness on a macrotidal sandy beach and to determine the best slope parameters to estimate runup. The results suggest that on that macrotidal sandy beach the slope of the active section of the upper beach should be used instead of the entire slope of the foreshore, the latter resulting in an underestimation of runup elevations when used in predictive equations from the literature. Results obtained with widely used equations are relatively well correlated with observed values ($r^2 = 0.63$). An analysis of the relationship between observed runup elevations and various variables has enabled the establishment of a runup estimation formula with a relatively good fit to the study site ($r^2 = 0.86$).

© 2012 Elsevier B.V. All rights reserved.

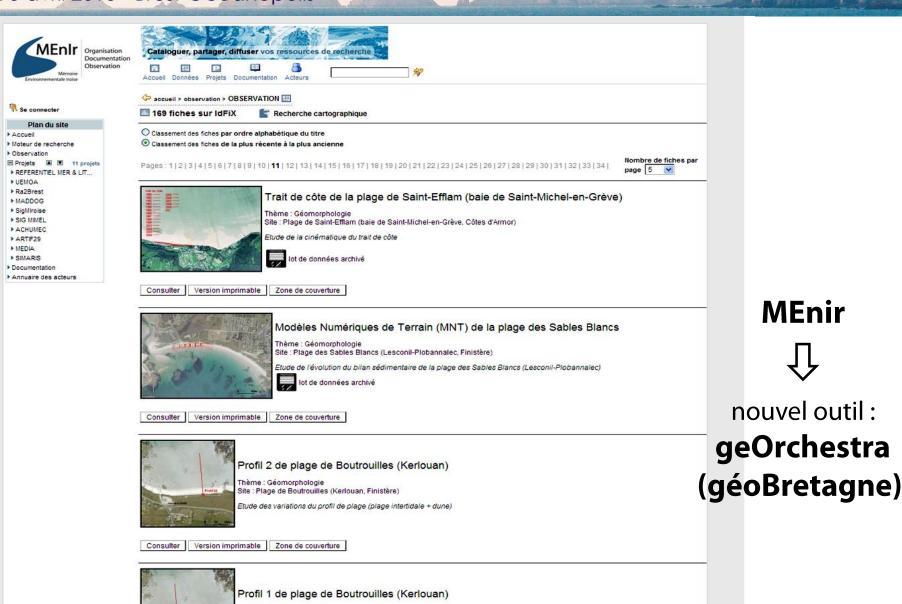








Archivage / visualisation



Thème: Géomorphologie

Site : Plage de Boutrouilles (Kerlouan, Finistère)

Etude des variations du profil de plage (plage intertidale + dune)

Archivage / visualisation

MAD DOG

Accueil Le projet Les sites Galerie photos Partenaires Contacts

Littoral

suivi . littoral . Bretagne

Mise A Disposition des Données d'Observations Géomorphologiques Littorales

Accueil

- Accueil
- Le projet
- Les sites
- Galerie
- Partenaires
- Contacts





Depuis plus d'une dizaine d'années, le recours à des techniques modernes de mesures de terrain (tachéomètre, théodolite, DGPS, Lidar, sondeur multifaisceaux, etc.) a facilité l'acquisition toujours plus importante et plus précise de données topo-morphologiques du domaine littoral.



Dans le même temps, le développement des outils de traitement et de catalogage de l'information géographique a permis d'améliorer et de valoriser l'archivage de ces données sous la forme de bases de données interactives.

Le projet MADDOG concerne le catalogage et la mise à disposition de données topo-morphologiques du domaine littoral de Bretagne.

Il s'inscrit prioritairement dans le travail de suivi mené au sein de l'Observatoire du Domaine Côtier (ODC) de l'Institut Universitaire Européen de la Mer (IUEM) dont une partie des séries est reconnue depuis 2005 comme Observatoire des Sciences de l'Univers (OSU), et dont la mission porte sur les trois domaines principaux des sciences de la mer et du littoral : le climat et la circulation océanique, la géophysique des domaines océaniques, et l'environnement côtier.

Le catalogage et la mise à disposition de ces données topo-morphologiques visent également à satisfaire une demande de plus en plus croissante des gestionnaires du littoral (services de l'Etat, collectivités territoriales, services maritimes, etc.), travaillant dans le domaine de l'application (gestion de l'érosion du trait de côte, élaboration des PPR submersion marine, etc.).

http://menir.univ-brest.fr/maddog/

Accès aux sites

Développement du suivi hydrodynamique \Rightarrow pour une meilleure compréhension des processus morphodynamiques = runup / setup



Mesure de houle et marée (wave gauge sensor) + topo-morphologie et la limite du swash runup (vidéo)

⇒ Financements LabexMer + ANR (COCORISCO) + SOERE















Collaborations avec le SHOM (division HOM) et IFREMER (LOS)
Soutien, technique : R. Cancouët sur

Soutien technique : R. Cancouët sur des financements LabexMer

Recrutement d'un post-doc sur des financements LabexMer + ANR COCORISCO (LDO et LETG-Géomer) − sept. 2013 ⇒ Analyse des dynamiques météorologiques et hydrodynamiques des tempêtes bretonnes à l'échelle des dernières décennies

- observation de la dynamique du trait de côte depuis la fin des années 1990 a permis d'identifier des phases d'érosion et de régénération des cordons littoraux en lien avec les variations de conditions météo-marines et hydrodynamiques.
- un inventaire des évènements morphogènes tempétueux en lien avec les dommages perpétrés en termes d'érosion et de submersion marine du littoral breton a été réalisé à l'échelle des dernières décennies.

<u>Objectif</u>: étude des conditions météorologiques et marines de ces évènements morphogènes tempétueux ⇒ rôle de l'ONA ? Probabilité d'occurrence conjointe entre les épisodes tempétueux et les marées de vive-eau ? Etc.

Dans le cadre de la « Stratégie nationale de gestion intégrée du trait de côte » le MEDDE lance une mission coordonnée par le BRGM sur l'homogénéisation des observatoires « trait de côte » gérés par les collectivités locales \Rightarrow vers un élargissement aux observatoires scientifiques

Vers une implication effective des collectivités locales (Région et CG) ? ⇒ exemple du Réseau d'Observation du Littoral Normand Picard (ROLNP) ⇒ regroupement des régions Basse et Haute-Normandie, et Picarde + Conservatoire du littoral qui soutiennent ce réseau d'observation

Signature future d'une convention sur 3 ans entre le GMGL-LDO UMR 6538 CNRS et le CG56 \Rightarrow connaissance, assistance et expertise des milieux littoraux sensibles dans le Morbihan :

- 1) aide à la mise en place de protocole / approche de suivi topographique et volumétrique des plages
- 2) formation et consulting des agents territoriaux du service ENS (espaces naturels sensibles)