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Tuesday August 21st Session B (Auditorium Vauquelin) Sediment transport and morphological change in estuaries and coastal zones 14:50 - 16:10



United Nations Educational, Scientific and . and Training Center on



Morphodynamic behavior of the Valahnúkur boulder barrier, SW Iceland

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Background & Topics

Review of coastal boulder researches



Boulders used as sedimentary signatures of palaeo-tsunami or storm events

Abundant literature on block mobility at the clifftop and on the rocky platform

Very few attention to boulder beaches as a typical morphodynamic environement

From Paris et al. (2011) – Mar. Geol., 283, 1-11.

Background & Topics

What we know about boulder beaches mobility and boulder movement?

Because it was hard to quantify accurately the mobility of boulders, our understanding of the morphodynamic of boulder beaches was based on the development of two complementary approaches over the last 40 years :



The equations were used to estimate the thresholds for the entrainment of boulders in order to distinguish between tsunamigenic and storm-associated deposits

What we know about boulder beaches mobility and boulder movement?

Recent studies on boulder accumulations (e.g. Perez-Alberti & Trenhaile, 2015; Perez-Alberti et al., 2015; Autret et al., 2017) propose new methodology to quantify boulders movements.

High resolution orthophotographs and DEMs were used to :

-accurately measure boulder's size
-quantify cross-shore and longshore boulder's movement
-better understand hydrodynamic processes involved in the sediment transport

The aim of this study is :

To provide new insights on the morphodynamic of boulder beaches using these new methodological advances.

In this presentation, we focus on morphological changes 1- over the last 40 years from a set of historical aerial photos and 2- during the last 4 years from a kite and drone survey.

We also attempted to define the role played by coastal storms in the morphological changes observed

The study area



The Valahnúkur boulder barrier



The Valahnúkur boulder barrier



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Historical shoreline changes

6 campaigns of aerial photos from the National Land Survey



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Ortho-correction method



Shoreline digitalization Coastline = base of the back-barrier

Quantification of shoreline changes along transects using DSAS (Digital Shoreline Analysis System)



Topo-morphological changes (period 2015-2018)

Kite and drone flights



Red targets as ground control points



DGPS measurements





Topo-morphological changes (period 2015-2018)

Structure from motion photogrammetry







4 Digital Elevation Models (DEMs)





Wave and tide data





Results. 1- Decadal shoreline changes from 1978 to 2017

Results. 1- Decadal shoreline changes from 1978 to 2017

Barrier retreat and storm chronology over the last decades







Results. 2- Topo-morphological changes from May 2015 to May 2018

Boulder movement on the crest West East Landward distance from the crest 317300 317300 317400 317300 317400 317400 Crest Period A **Period B** Period C 372700 372700 372700 60 40 Distance (m) 372600 372600 2600 Projected Projected Projected 372500 372500 boulders **boulder**⁺ boulders from 2015 to 2016 from 2016 to 2017 from 2017 to 2018 <u>100</u> m 25 50 <u>100</u> m 25 50 <u>100</u> m 25 50 317300 317400 317300 317300 317400 Number of boulders moved 1000 2015-2016 2016-2017 2017-2018 800 600 400 N: 557 N: 6971 N: 4057 200 0 10 15 20 25 30 35 40 35 15 20 25 35 1 5 1 5 10 15 20 25 30 40 1 5 10 30 40 Landward distance (m) Landward distance (m) Landward distance (m)

Results. 2- Topo-morphological changes from May 2015 to May 2018

Results. 3- Hydrodynamic conditions from 2015 to 2018

- Mostly wave dominated : low tidal range (± 2m) \ very high Hs
- Max. Hs = 14.5 m (Dec. 2016)



Results. 3- Hydrodynamic conditions from 2015 to 2018

- Based on the 75e and 98e percentiles : 35 storms between 2015-2018 (mainly Dec. to Feb.)
- Longer storms in 2018 : entire weeks of continuous storms



Results. 4- Sediment budget



A significant northward longshore drift (≈1000 m³)

Sediment supplies from the south (from ≈ 300 m³ to ≈500 m³)

Discussion. The source of boulders







Major cliff retreat between 1981 and 1984 due to the most powerful storm of the 20th century in December 1981.

Significant sediment supplies from the south related to the erosion of lava cliffs (575 m³/a over the last 40 years)

A trend to the decrease of sediment supplies during last 2 decades ?



Conclusion

Summaries

Over the last 40 years :

- Significant morphological changes
- Mean landward migration rate of about 0.4 m/a
- High temporal variability of migration rates -> role of major coastal storms

During the last 4 years :

- a strong longshore drift
- swash regime during fair weather period ;
- overtopping regime during high water levels ;
- overwashing regime during storm events

Perspectives

- Understand swash and runup processes
- Continuation of the topo-morphological survey

