STORMS: A CHALLENGE OF KNOWLEDGE

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Introduction

Dealing with storms is always a fascinating matter. They are uncontrollable and destructive. It is not always possible to get real data measurements during a storm due to large magnitudes involved. Having recording instruments deployed on the seafloor and properly working, gave the rare opportunity to observe and analyze the storm impact directly on the sea-floor.

This paper presents the effects of two storms on a measuring object deployed on the seafloor in shallow water. The experimental area has a water depth range between 7 to 12 meters, depending on tides. Two storms passed the experiment site during a three months experiment directed towards a better understanding of the sand mobility in a highly dynamic environment.

Area of investigation

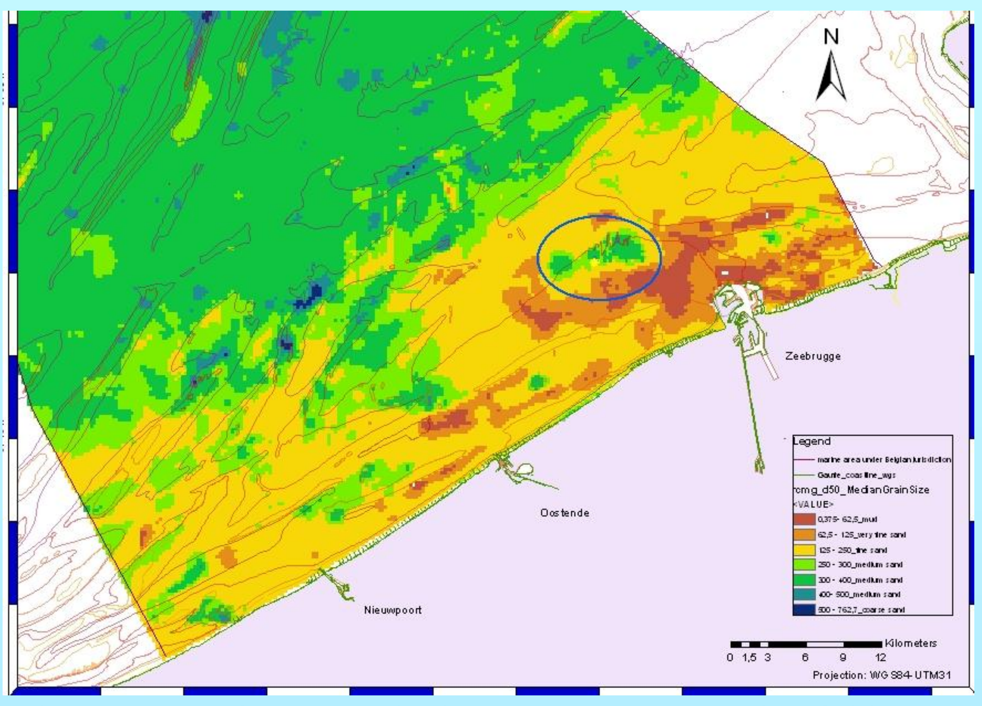


Fig. 1: extract from a grain size map on the BCS. (Verfaillie et al., 2006)

The experimental area named Wandelaar (blue circle in figure 1) is located at 12 km distance from the port of Zeebrugge in the vicinity of the main navigation channel on the Belgian part of the North Sea. It is a sandy shallow water area characterized by the presence of small to large dunes (sensu Ashley, 1990), of up to 2 m in height.

Measuring instrument

Fig. 2: BRM: experimental instrument

The Burial Recording Mine (BRM) is an experimental instrument recording presence or absense of sediment at programmed time recording. With its 3 rings of 24 led bridges (sensors) equally spaced on its sides and its centre detects the sediment height surrounding itself once is deployed on the sea-floor. It has a lenght of 1.70 m, diameter of 0.47m and weight in air of 500 Kg. Accelerometers inside the object monitor the pitch and the roll and their variation in time.

Storm 1

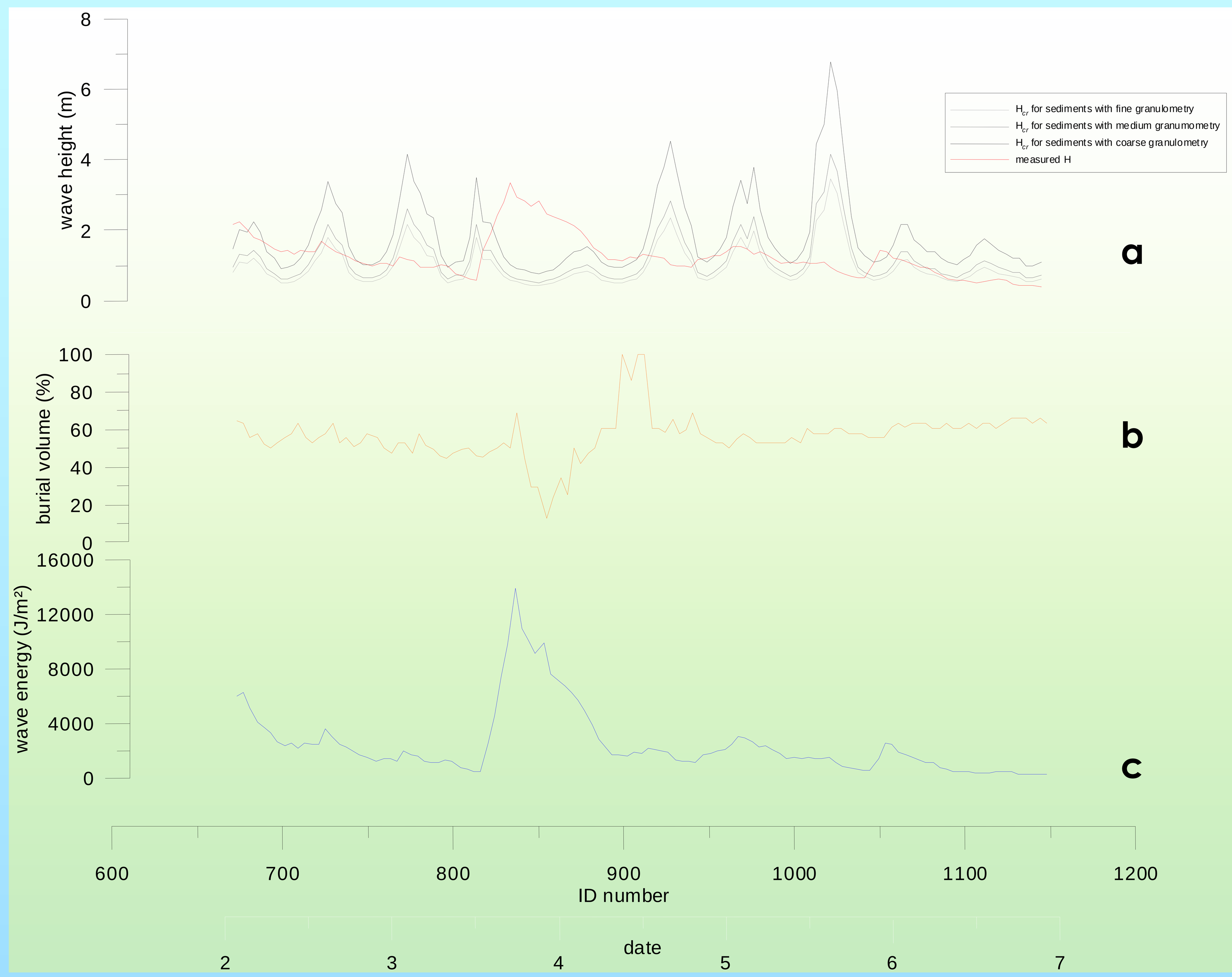


Fig. 3: storm in October 2008. (a): comparison between measured curve of real wave height (red) and calculated curves of critical wave height (different tone of grey); (b): curve of burial volume; (c): curve of wave energy.

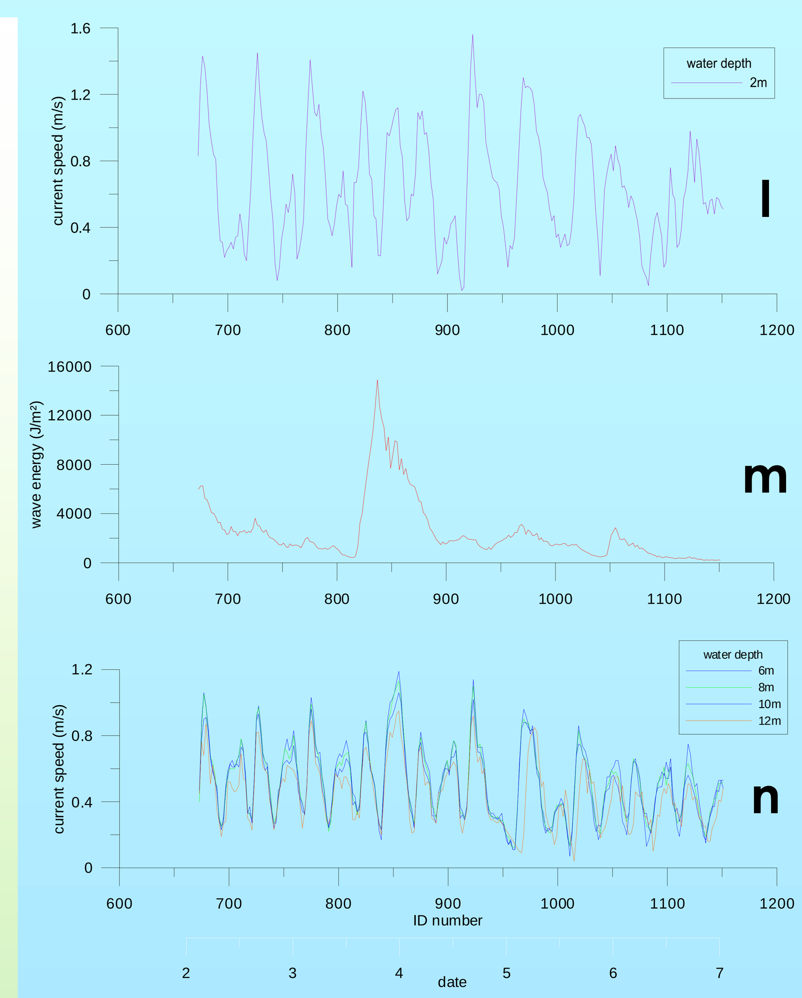
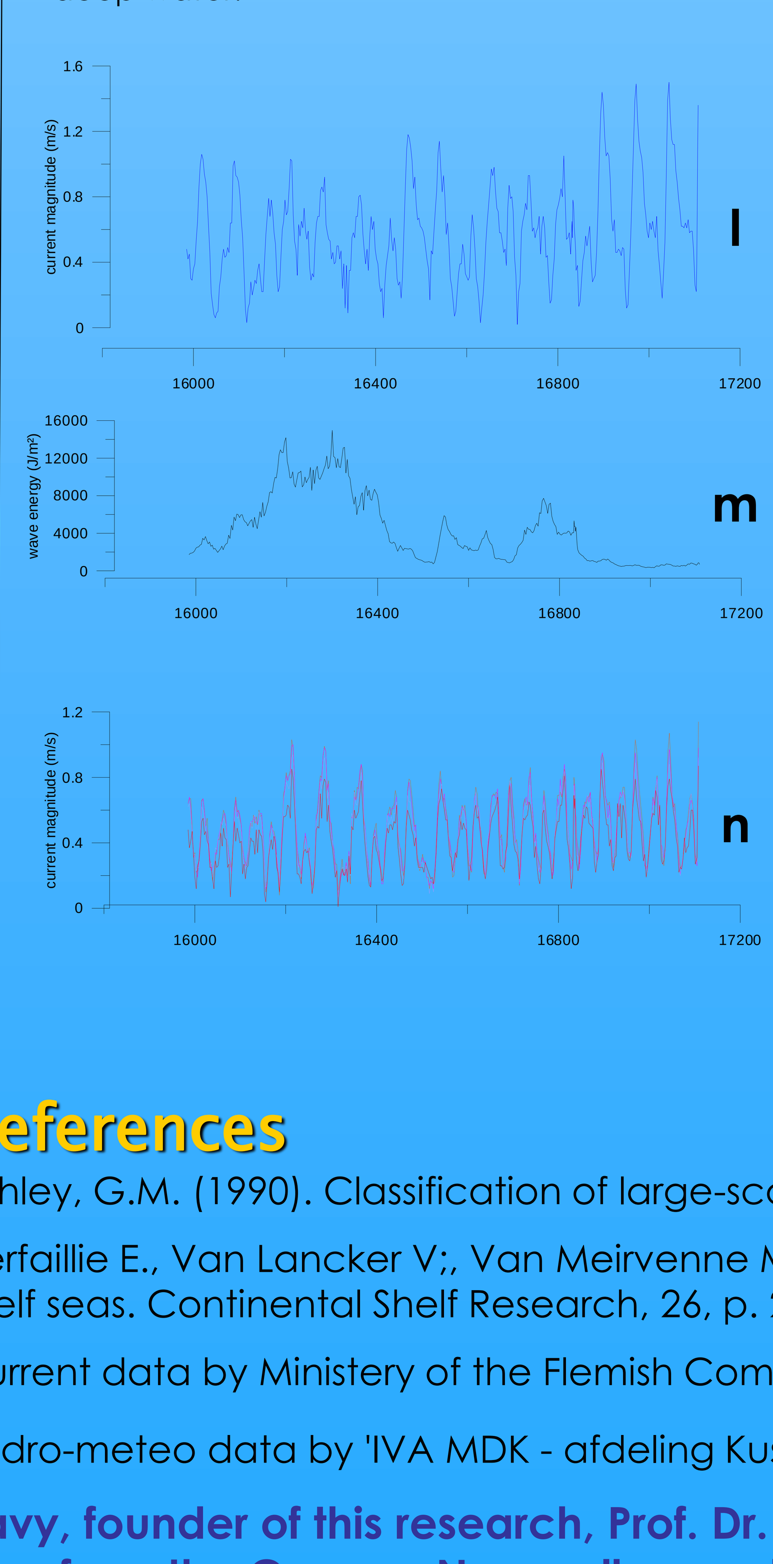


Fig. 4: storm in October 2008: comparison between measured curves of current speed (l and n) and calculated curve of wave energy (m). Curve l represents current speed measured for superficial layer of water depth, curve n for deep water.

The hydrological and meteorological data were analyzed to evaluate the two storms affecting the area during the experiment. The threshold necessary to initiate movement of sand grains on the seafloor was calculated. The threshold orbital velocity for sediment motion is used to calculate the corresponding required critical wave height.
The calculated curves were compared with the measured wave height, percentage of sediment volume around the object, and current measurements.

Storm 2

Fig. 5: storm in November 2008: comparison between measured curves of current speed (l and n) and calculated curve of wave energy (m). Curve l represents current speed measured for superficial layer of water depth, curve n for deep water.



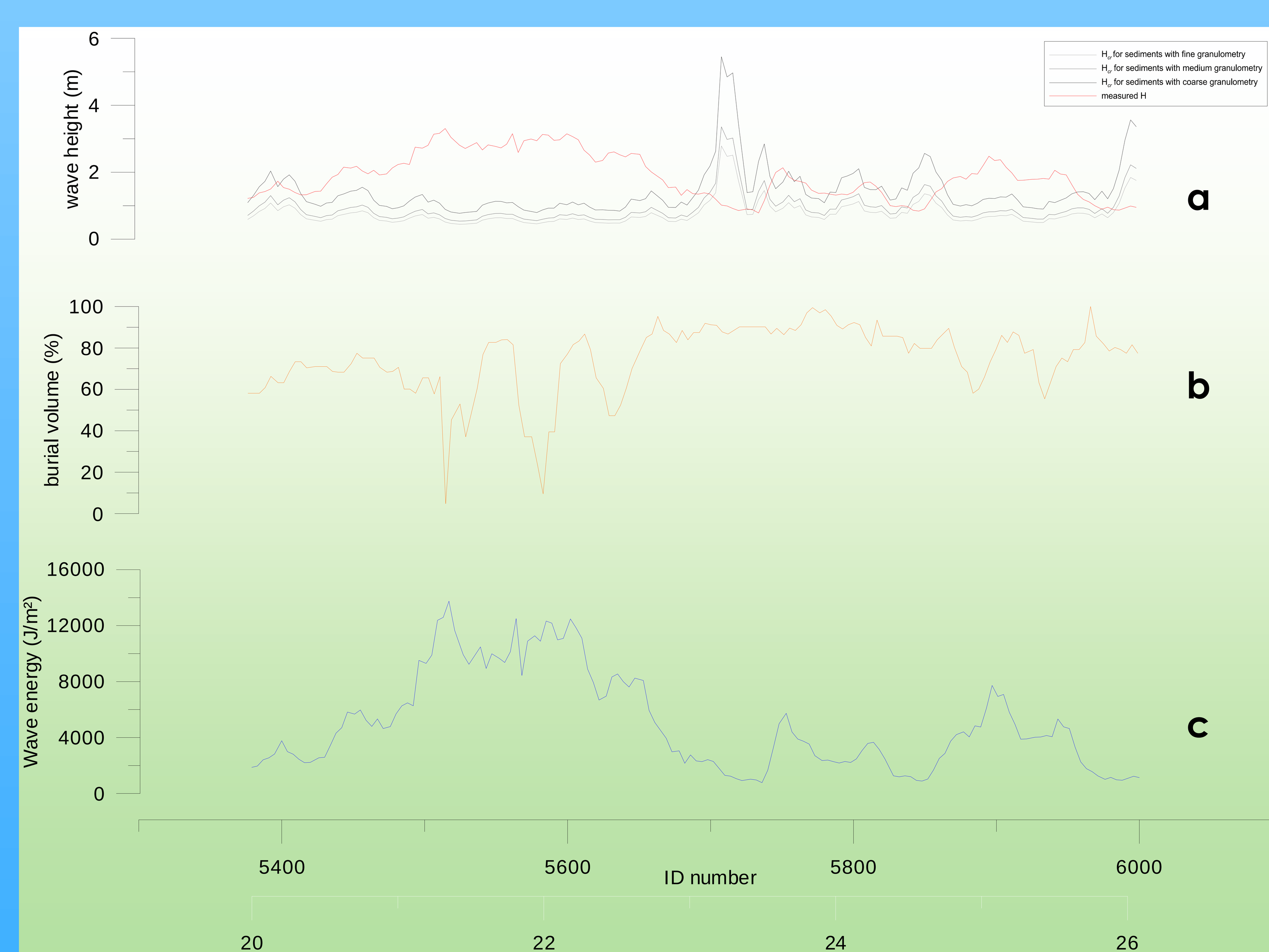


Fig. 6: storm in November 2008. (a): comparison between measured curve of real wave height (red) and calculated curves of critical wave height (different tone of grey); (b): curve of burial volume; (c): curve of wave energy.

Conclusion

During both storms wave affecting the seafloor caused reduced burial (i.e., sediment coverage) of the BRM. After the storms increased burial of 60% (October) and 80% (November) was observed. The high storm waves eroded sediment in the vicinity of the BRM and created scour holes at both ends. Once the scour holes merged to form one, the BRM rests on a small sediment cone. Upon collapse of the cone the BRM rolls into the bigger scour hole. During the sedimentation phase this new deeper hole is filled and causes a higher percentage of buried volume.

References

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Current data by Ministery of the Flemish Community, Maritime Services, Coastal Division/Hydrography

Hydro-meteo data by 'IVA MDK - afdeling Kust - Meetnet Vlaamse Banken'

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