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Geomorphological and sedimentological effects of historical storm surges at selected locations along south-eastern Baltic coast – summary of PhD thesis

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PhD thesis required fulfilment of following aims: recognition of landforms formed under storm surges, identification of lithological features of storm sediments, and comparison of sedimentary record with historical events through identifying the age of the sediments. To fulfil above requirements, data about historical storm surge events was gathered from scientific papers, cronicles, and newspapers. Based on digital spatial data, several key sites were selected to detail field work, during which geomorphological survey and collecting of cores and surface samples was done. After preliminary analyses and pre-treatment, grain size, quartz grain morphology, heavy minerals, and loss on ignition analyses were applied. The age of sediments was estimated with ^{37}Cs , ^{210}Pb and ^{14}C methods.

Geomorphological survey indicated, that influence of storm surges on coastal area was significant at a few locations. The considerable variety of landforms was recognized at Mierzeja Messyńska, where dune erosions, incised channels, perched fans, and washover terraces were observed. In other locations variety of landforms was limited to dune erosions and perched fans.

Storm surge sediments showed notable variety of sedimentological features (e.g. different kind of stratification, rip-up clasts, erosional bottom boundary). Grain size distributions in storm surge sediments were mainly unimodal, moderately well sorted, fine skewed, and mesokurtic. Quartz grains showed lower roundness and sphericity than other kind of sediments. Mineral composition was dominated by light mineral fraction (85-99%). In heavy mineral fraction there was notable increase content of very dense minerals of rounded shape (e.g. garnets, zircon, staurolite).

Geomorphological and sedimentological analyses indicated two different mechanism of storm surge sediments formation. At Mierzeja Messyńska sediments

were formed under breaching regime, while at Puck Bay coast sediments were formed under inundation regime. Comparison of samples of storm surge origin with samples collected in neighbour sedimentary environments (dune, beach, nearshore, river) showed the possibility of distinguishing them from each other with grain size distributions, quartz grain morphology, and heavy mineral composition.

Dating results showed that at Hel Peninsula only storms from 1824 or 1825, and 1898-1914 were recorded. Some of sedimentary features suggested possible record of storms from 1497 and 1625. At Puck Bay coast storm from 1872 left continuous sand layer. At Mierzeja Messyńska storm record was limited to the storm of 1872 and period of 1898-1914. These results suggest increasing intensity of storminess through last millennium, but on the other hand, showed that there were no storm surges strong enough, to form any sedimentary record for last over one hundred years.

Provided results showed promising possibility to relate sedimentological features of storm sediments with historical events, which may help in similar investigations in the future and estimation of storm surge parameters based on geological record. Sedimentary record of storm surges along south-eastern Baltic coast also showed the need of further research to build more detail extreme storm surge chronology. In the light of contemporary climate change and following sea-level rise, usage of geological record which exceed the period of instrumental measurements may be crucial in marine flood risk estimation.