Sediment budget on the eastern and southern coasts of the Baltic Sea

Summary

The proposed PhD studies focus on the understanding of the impact of timing and synchronisation of wave storms and high water level events on the properties of wave-driven sediment transport along sedimentary shores of the eastern and southern Baltic Sea and on the total sediment budget on the shores of this region. The central goal is to build an adequate estimate of sediment budget on these shores by combining i) observed data about changes to the location of the coastal scarp and the waterline and ii) numerical estimates of wave-driven sediment transport on the underwater part of the beach.

Research field:	Earth sciences
Supervisors:	Prof. Dr. Riina Aav Kevin Ellis Parnell
Availability:	This position is available.
Offered by:	School of Science Department of Cybernetics
Application deadline:	Applications are accepted between June 01, 2020 00:00 and July 03, 2020 23:59 (Europe/Zurich)

Description

The gradual increase in the relative water level along most of the eastern and southern shores of the Baltic Sea (Hünicke et al. 2015) and the projected increase in the frequency of wave storms and extreme water levels (Pindsoo and Soomere 2016) creates a rapidly increasing pressure on sedimentary coasts of the Baltic Sea. This pressure is further amplified by possible changes in the wave approach directions (Soomere et al. 2015; Kudryavtseva and Soomere 2017). This change may radically alter the structural properties (such as the location of divergence and convergence areas; Viška and Soomere 2013) of wave-driven alongshore transport. This in turn not only affects erosion and accretion areas but has also major implications on the maintenance and planning of various coastal engineering structures (harbours, breakwaters, groins etc.).

The existing atmospheric, ocean circulation and wave models make it possible to reliably reconstruct the main features of nearshore wave fields and water levels and thus also the wave-driven transport and to some extent the loss of sediment. Most of the research into wave-driven sediment transport until now has been performed in terms of statistical properties of wave fields. In other word, the actual sequences of events are ignored. This approximation is very crude in the Baltic Sea conditions where the classic „cut and fill“ process usually does not occur and where the local effects may substantially contribute the actual water level near the waterline (Pindsoo and Soomere 2015). In particular, this approximation leads to systematic biases in estimates of the basic properties of sedimentary beaches (Soomere et al. 2017).

Responsibilities and tasks
The PhD candidate shall:

- evaluate the recession rates of the coastal scarp and the changes in the location of the waterline from available monitoring data;
- establish the structural properties (the areas of divergence and convergence) of wave-driven sediment transport and their stability in space and time;
- estimate the „impact“ of synchronisation of wave storms and changes in the water level on the basic properties of beaches such as the closure depth or the width of the equilibrium profile;
- numerically estimate the changes in amount of sediment in the underwater part of the beach;
- quantify the sediment budget (loss or gain of sediment) along the study area by combining the estimates for the dry beach and for the underwater part of the beach.

Qualifications: MSc degree or equivalent qualification in one of the following fields: Earth sciences, physical oceanography, coastal engineering, ocean engineering, mathematics, physics, remote sensing.

The applicants should fulfill the following requirements:

- experience with common scientific software (e.g. Matlab, Python);
- very good command of English.

References:

Hünicke, B., Zorita, E., Soomere, T., Madsen, K.S., Johansson, M., Suursaar, Ü. 2015. Recent change – sea level and wind waves. In: The BACC II Author Team, Second Assessment of Climate Change for the Baltic Sea Basin, Regional Climate Studies, Springer, 155–185, doi: 10.1007/978-3-319-16006-1_9

Kudryavtseva, N.A., Soomere, T. 2017. Satellite altimetry reveals the impact of rotating winds on spatial patterns of variations in the Baltic Sea wave climate. Earth Systems Dynamics, 8, 697–706, doi: 10.5194/esd-8-697-2017

Pindsoo, K., Soomere, T. 2015. Contribution of wave set-up into the total water level in the Tallinn area. Proceedings of the Estonian Academy of Sciences, 64(3S), 338–348, doi: 10.3176/proc.2015.3S.03

Soomere, T., Pindsoo. K. 2016. Spatial variability in the trends in extreme storm surges and weekly-scale high water levels in the eastern Baltic Sea. Continental Shelf Research, 115, 53–64, doi: 10.1016/j.csr.2015.12.016

Soomere, T., Bishop, S.R., Viška, M., Räämet, A. 2015. An abrupt change in winds that may radically affect the coasts and deep sections of the Baltic Sea. Climate Research, 62, 163–171, doi: 10.3354/cr01269

Soomere, T., Männikus, R., Pindsoo, K., Kudryavtseva, N., Eelsalu. M. 2017. Modification of closure depths by synchronisation of severe seas and high water levels. Geo-Marine Letters, 37, 1, 35–46, doi: 10.1007/s00367-016-0471-5

Viška, M., Soomere, T. 2013. Simulated and observed reversals of wave-driven alongshore sediment transport at the eastern Baltic Sea coast. Baltica, 26 (2), 145–156, doi: 10.5200/baltica.2013.26.15

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