Higher dunes, deeper sea

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The Belgian coastline separates the North Sea from the low-lying hinterland. This sandy coast is fringed by alternating stretches of natural dunes and man-made sea dikes, that protect the hinterland from flooding. These structures are required to meet the safety standards, recently revised in the *Masterplan Coastal Safety* (Afdeling Kust, 2011). Currently, the *Complex project coastal vision* (Weyts, 2017) aims for further improvements towards 2100. To assess coastal safety, each year the coast's altitude is measured. These measurements reach from the dunes up to 1500 m offshore. With measurements starting already in the 1970's, the Belgian coast is amongst the best monitored in the world. On decadal time-scales, the Belgian nearshore zone has gained sediment at a rate of 10^6 m^3/year. Natural feeding and artificial sand nourishment contribute equally to this increase (Roest, 2019). Furthermore, Strypsteen et al (2019) concluded that natural dunes grow linearly in time, at an average rate of 6 m^3/m/year. Historically the survey data were only processed to sediment volumes per coastal section (Houthuys, 2012). While useful for the determination of long-term trends, these volumetric data do not provide information on changes in the coastal profile shape. Raw point-clouds, on the other hand, are difficult to compare or to process. A standard grid of cross-shore oriented transects overcomes these difficulties.

Digitally available surveys covering the entire Belgian coast are available as of 1997. These surveys are merged in a continuous Digtital Elevation Model (DEM) per year. From these newly derived data, it appears that erosive trends are mostly found in tidal channels (Kleine Rede, Grote Rede, Appelzak) and next to dredged access channels (Oostende). Erosion rates there average around 2 cm/year, with significant extremes in access channels due to dredging. Along the Grote Rede, the transition from the sloping shoreface towards the flat seabed is migrating onshore, manifesting itself as erosion up to 10 cm/year. Contrastingly, accretive trends are concentrated on the dune front and dry beach, with an average rate in the order of 2 cm/year, much larger than current sea level rise. Both natural feeding (Aeolian transport) and beach nourishments contribute to this accretion. Furthermore, accretive zones are found in the wave shadow zones of the Zeebrugge and Oostende breakwaters. Continued accretion of the dry beach and dune front combined with erosion of the shoreface leads to an overall steepening of the beach profile. Eventually this may harm the overall stability of the coast.

Bibliography

- Afdeling Kust. (2011). *Masterplan Kustveiligheid*. Oostende: Maritieme Dienstverlening en Kust. Afdeling Kust.
- Houthuys, R. (2012). Morfologische trend van de Vlaamse kust in 2011. Agentschap Maritieme dienstverlening en Kust, Afdeling Kust, Oostende.
- Roest, L.W.M., (2019). Sediment budget of the Belgian coast, in: Crest Scientific report.
- Roest, L.W.M., (2019). Combined topography and bathymetry of the Belgian coast, interpolated to cross-shore transects (1997-2019), *dataset*.
- Strypsteen, G., Houthuys, R., and Rauwoens, P. (2019). Dune evolution at decadal timescales and its relation with potential aeolian transport. *Journal of Marine Science and Engineering*, 7(10), 357.
- Weyts, B. (2017). Startbeslissing Complex Project Kustvisie, Nota aan de Vlaamse regering.

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