Introduction
Coastal safety in the Netherlands is threatened by severe dune erosion (Fig 1). If dunes breach, the low-lying hinterland will flood. Dune erosion results from storm surges and waves generated by storms in the North Sea basin. The wave climate consists out short-waves and infragravity waves (period >30 sec). Dune erosion is caused by short- and infragravity wave breaking on the dunes.

Here, we study the impact of the steepness of the profile on the near-shore wave climate under different sea levels. Subsequently, the impact of sea level rise (SLR) on dune erosion volumes is discussed.

Methods
All simulations are executed with XBeach, a process-based model, calibrated for the Dutch coast. Safety standards in the Netherlands require a primary defence to withstand a 1:10,000 year event. These standards are here used as offshore boundary conditions.

Waves and sea level rise:
- 3 locations (Fig 2, Egmond, Petten and Ameland) with different slopes (Fig 3h-i)
- Offshore wave conditions are the same for these simulation: wave height (Hs) = 9.55 m, wave period (Tp) = 16.1 s
- See Table 1 for offshore water levels
- Topography remains unaltered during the simulations

Dune erosion and sea level rise
- The impact of SLR on dune erosion is analyzed for 2 locations (Fig 2, Egmond and Noordwijk) with varying offshore boundary conditions:
  - Egmond: storm surge = +4.5 m, Hs = 9.55 m, Tp = 16.1 s
  - Noordwijk: storm surge = +4.8 m, Hs = 8.55 m, Tp = 14.3 s
- See Table 2 for offshore water levels
- Topography changes during simulations, morphology active

Dune erosion and sea level rise
- Erosion volumes increase by approx. 25% with 0.8 m SLR (Fig 5).
- Model runs show a linear relation between the increase in dune erosion volumes and SLR (Fig 5).
- This relation is site specific, since hydrodynamical boundary conditions vary per site.
- Retreat distance is unrelated to SLR (Bruun-rule not applicable) (Fig 4d).
- Increase in erosion volumes are the result of higher point of impact (higher water levels) of the waves on the dune front due to SLR.

Conclusions
- Height of near-shore, short waves increase with sea level rise, for all profile slopes
- Infragravity wave height is independent of SLR.
- Level of attack (water level) is dominant for increase in dune erosion, not the increase in short waves.
- Linear relation between SLR and erosion volume (approx. 25% more dune erosion with 0.8 m SLR).
- Retreat distance and SLR are uncorrelated. Bruun-rule not applicable