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Shoreward Propagating Accretionary Waves (SPAWs): Observations from a multiple sandbar system

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Motivation

The onshore transport of sand from surf zone sandbars to the beach-dune system allows sandy coasts to recover from storm-driven erosion. Sandbars are generally perceived as alongshore continuous ridges of sand, but shallower parts have been observed to separate from the bar and migrate onshore as spatially coherent features, termed Shoreward Propagating Accretionary Waves (SPAWs). We hypothesize that SPAWs induce alongshore-variable beach-dune recovery.

Here, we aim to quantify

1) **SPAW occurrence**
2) **Characteristic bar morphodynamics**
3) **Characteristic wave conditions**

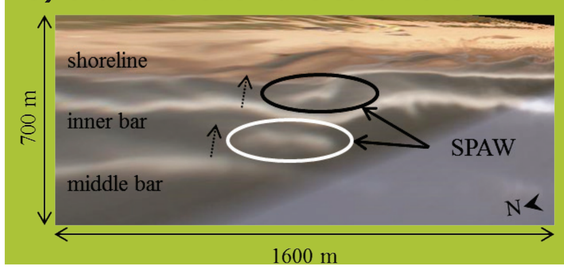
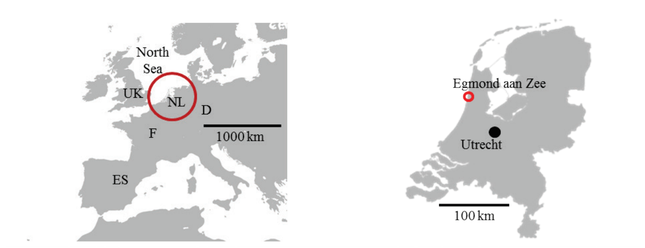


Figure 1 SPAWs, as seen in a time-exposure planview image of the surf zone.

Field site: Egmond aan Zee (NL)



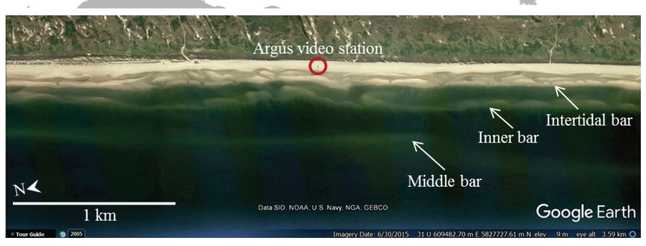


Figure 2 Location of the field site. This wave-dominated, microtidal straight stretch of coast contains three subtidal bars and an ~50-m wide beach backed by a dune system. The bars exhibit net offshore migration over a period of ~15 years, before decaying ~700m offshore.

Data

- 15 years
- 4 km alongshore
- Daily time-exposure planview images
- Hourly wave conditions

Figure 3 The Argus monitoring tower (†2017) was located 3 km south of Egmond aan Zee, where the coast is undisturbed by sand nourishment activities.

SPAW occurrence

Numbers	
SPAWs observed	**93**
middle → inner	41
inner → beach	52
SPAWs/year	**6.6**
middle → inner	2.9
inner → beach	3.7
Lifetime (days)	**40**
middle → inner	60
inner → beach	25
% merged	**50**
Dimensions	**200 x 30 m**
Migration rate	**1.3 m/day**

- **SPAWs increasingly emerge from the inner bar during Net Offshore Migration of the bars (Figure 5).**
- **SPAWs either emerged from horn detachments or bar bifurcations (Figure 4)**

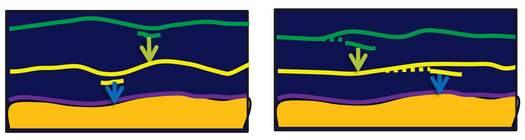


Figure 4 SPAW emergence.

- **50% of SPAWs disappeared before welding ashore, under energetic, obliquely incident waves (Figures 6 and 7).**

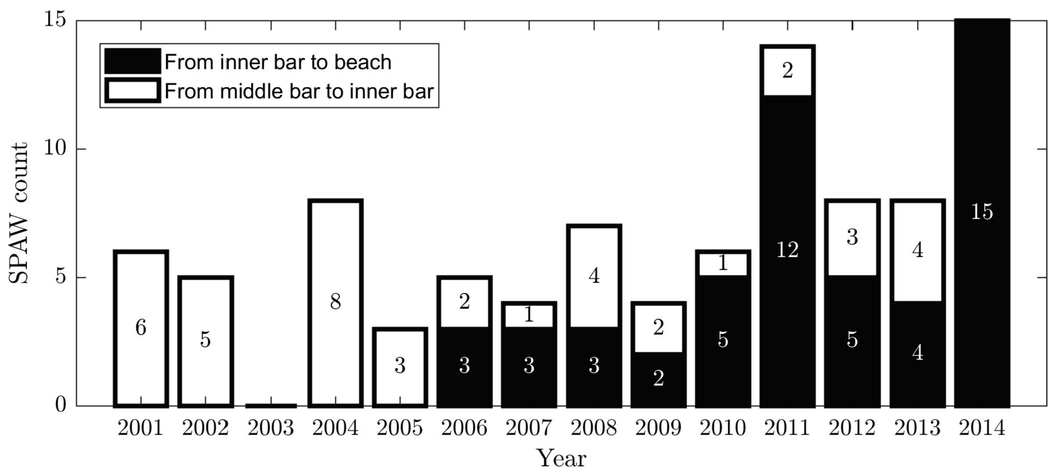
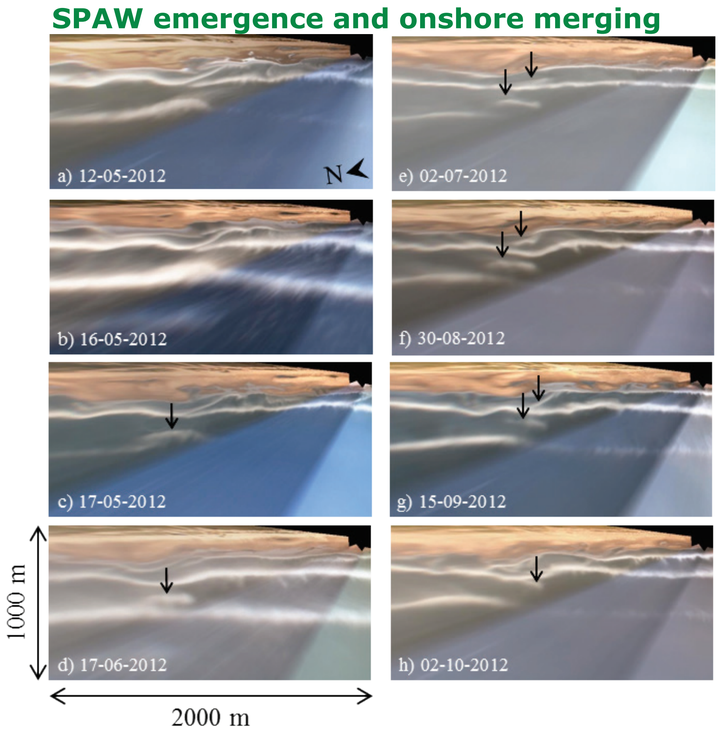


Figure 5 Observations of annual SPAW occurrence.

SPAW emergence and onshore merging



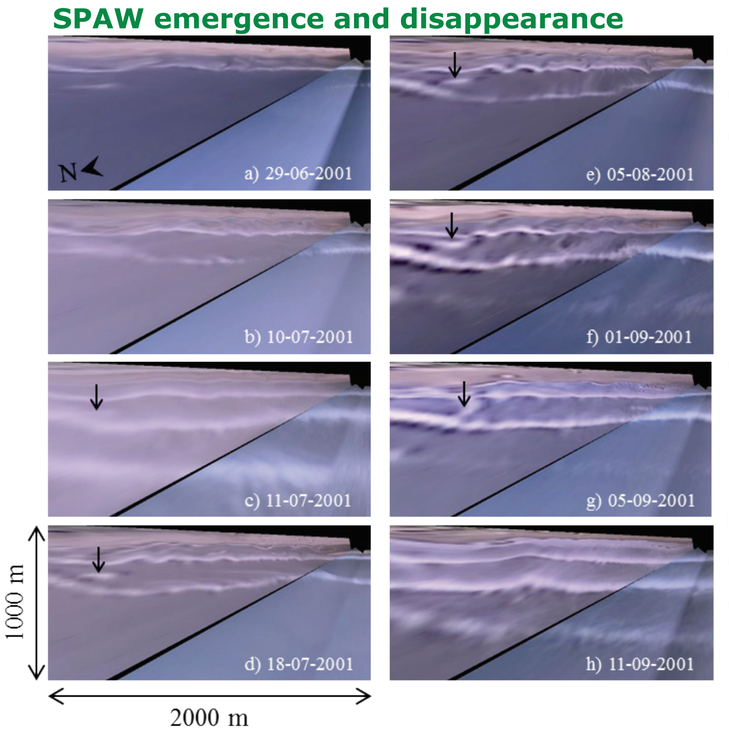
Emergence
- Middle bar horn
- Inner bar bifurcation
- Waves: 1.5 - 2 m, obliquely incident

Migration
- Prolonged low-energetic conditions
- Waves: 2 m shore-normally incident

Merging
- Prolonged moderately-energetic conditions

Figure 6 SPAWs weld ashore during shore-normal waves.

SPAW emergence and disappearance



Emergence
- Middle bar horn
- Waves: 1.5 – 2 m, obliquely incident

Migration
- Prolonged low-energetic conditions

Disappearance
- SPAW diffusion
- Waves: 1.5 – 2 m, obliquely incident

Figure 7 SPAWs disappear during oblique wave incidence.

Conclusions

SPAW emergence
Alongshore variable sandbars + energetic waves
Increasingly emerge from inner bar during NOM-cycle

SPAW migration
1-2 months of moderately energetic, shore-normal waves

SPAWs disappearance
Energetic, obliquely incident wave events

Implications

Estimated SPAW volume : 15000 m^3
6.6 SPAWs /year over 4000 m

25 m^3/m/year onshore sand transport from bars to beach

(previously observed aeolian transport from intertidal beach to dunes :10-15 m^3/m/yr)

Acknowledgement
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Please see our Coastal Dynamics 2017 proceeding for more info on this research.