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

SPAW occurrence

<table>
<thead>
<tr>
<th>Numbers</th>
<th>SPAWs observed 93</th>
</tr>
</thead>
<tbody>
<tr>
<td>middle → inner</td>
<td>41</td>
</tr>
<tr>
<td>inner → beach</td>
<td>52</td>
</tr>
<tr>
<td>SPAWs/year</td>
<td>6.6</td>
</tr>
<tr>
<td>middle → inner</td>
<td>2.9</td>
</tr>
<tr>
<td>inner → beach</td>
<td>3.7</td>
</tr>
<tr>
<td>Lifetime (days)</td>
<td>40</td>
</tr>
<tr>
<td>middle → inner</td>
<td>60</td>
</tr>
<tr>
<td>inner → beach</td>
<td>25</td>
</tr>
<tr>
<td>% merged</td>
<td>50</td>
</tr>
</tbody>
</table>

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

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

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

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 m³
6.6 SPAWs/year over 4000 m

25 m³/m/year onshore sand transport from bars to beach
(previously observed aeolian transport from intertidal beach to dunes: 10-15 m³/m/yr)

Field site: Egmond aan Zee (NL)

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

Acknowledgement
This work is part of the project Spawning sand from sea to land, funded by the Netherlands Organisation for Scientific Research (NWO), under contract 016.Veni.171.101
Please see our Coastal Dynamics 2017 proceeding for more info on this research.