Beach morphodynamics

How understanding beaches might one day save your life

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What you will learn

What is a beach?

Waves

- Why do waves form?
- Why do they break at the coastline?

During and after wave breaking….

- 1) What happens to the water?
- 2) What happens to the sediment?
- Answering questions 1 and 2 is the basis for **beach morphodynamics**

Where is it safe to swim?

Maintain a focus on the sandy beaches of Skåne and Halland

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What is a beach?

An accumulation of sediment deposited by waves

Sand, but also coarser grain sizes

- e.g., Gravel and cobbles
- In southern Sweden, beaches are derived from glacial sediments
- Reworked by waves, currents, wind

Finer sediments do not form beaches

- Silt and clay

Key point

- **The larger the grain size, the steeper the beach**

Mixed sand, gravel and cobble beach at Kåseberga (Photo Elisabeth Magnusson)

Sandy beach at Skälderviken (photo: Elisabeth Magnusson)

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Mixed sand and gravel beach, Cable Bay, New Zealand (Photo: Rob Brander)

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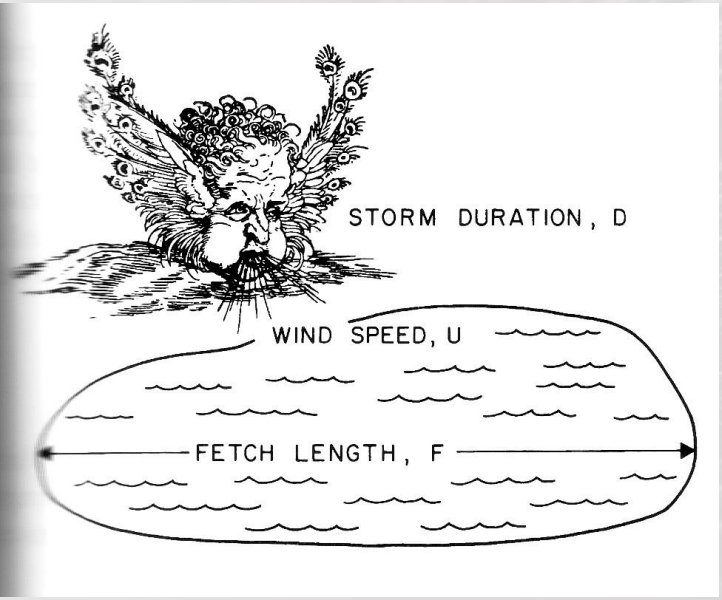
Why do waves form?

Wind



Wave height (wave energy) Determined by:

1. The area over which wind blows
2. Wind strength
3. Wind duration

Key point

Baltic Sea coastline:

- generally low energy,

- intermediate energy during windy summer days and winter storms,

- rarely, if ever, high energy

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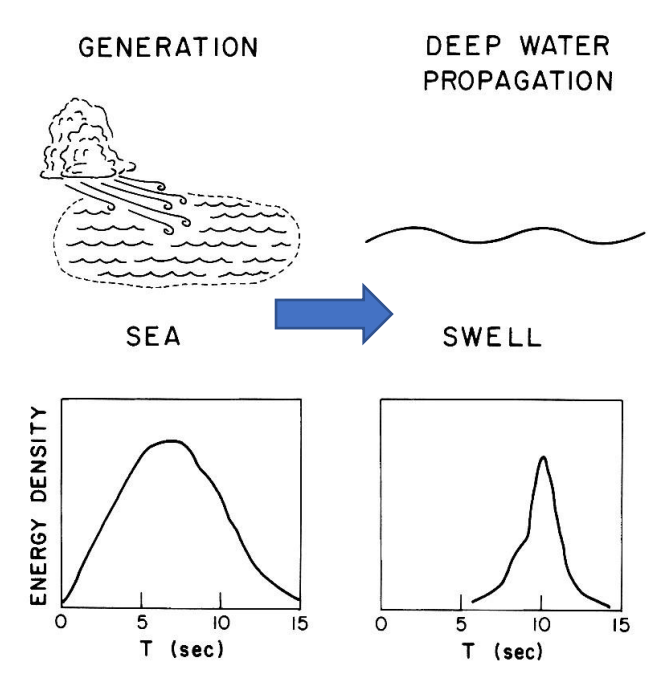
Why do waves break?

Waves self-sort into dominant wavelengths and frequencies

- Because it is more efficient
- Waves can travel 100s – 1000s of km

Waves release (dissipate) energy at the coast by breaking



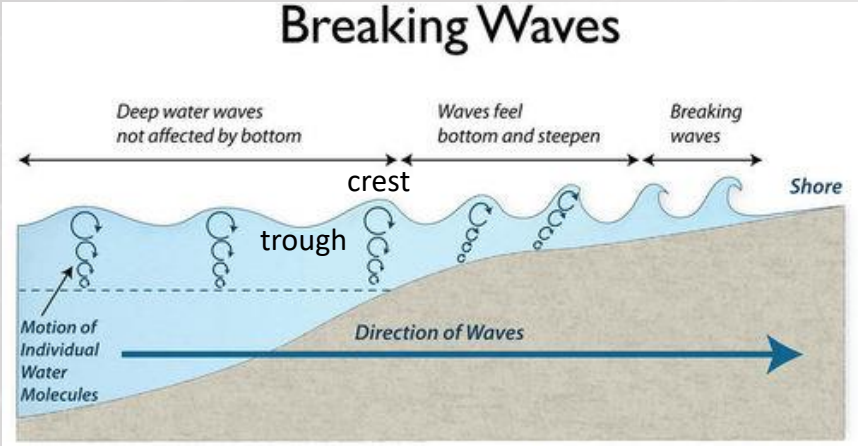
Breaking happens because waves change shape in shallow water

- Troughs flatten and crests steepen
- Wave energy travels faster in deeper water
- The wave crest travels faster than the trough, so the wave breaks

Key point

Waves preferentially break in shallow water:

- at coastlines, on sand bars



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Raglan, New Zealand (Photo: Rob Brander)

Tairu Beach, New Zealand (Photo: Rob Brander)

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2 key questions: What happens to the water?

What happens to the sediment?

Waves push water landwards

That water returns to the sea

Three pathways:

1. Drainage through sediment

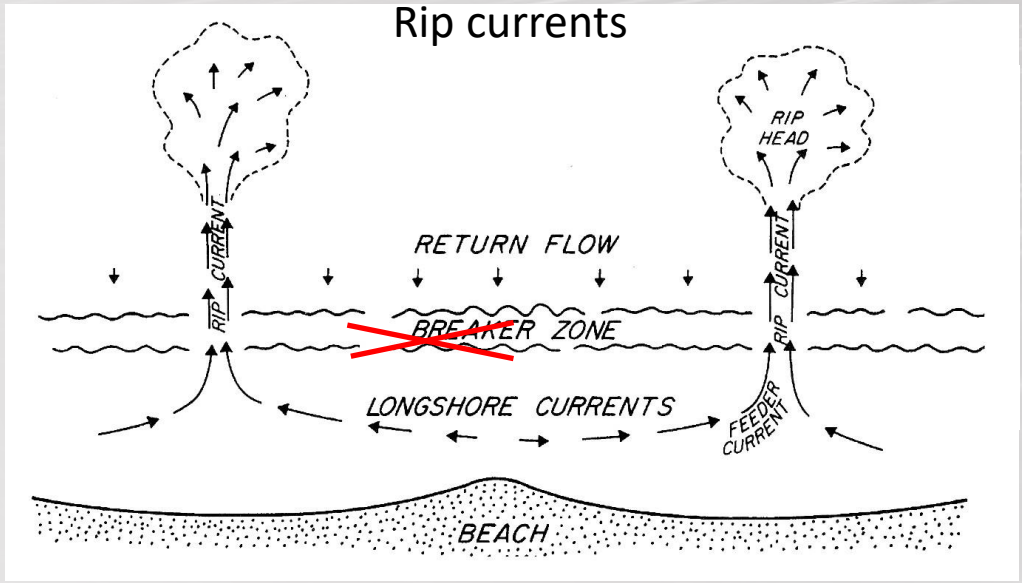
Key point

2. High-energy beaches

- Vertical flow segregation
- Bed return flow

3. Intermediate-energy beaches

- Lateral flow segregation
- Rip currents



2 key questions: What happens to the water? What happens to the sediment?

Moving water transports sediment

Water driven shorewards by waves builds beaches

Bed return flow and rip currents erode beaches

Key point

Beach morphologies reflect the balance in:

1. Onshore sediment transport by waves

2. Offshore and longshore transport by currents

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Beach morphodynamics

Beach morphologies generated through sediment transport by waves and currents

Morphologic control on waves and currents

- Rip channel location governs rip current location
- Wave breaking on sand bars

Key point

Beach morphodynamics:

1. **Control exerted by waves and currents on beach morphologies**
2. **Control exerted by morphogies on waves and currents**

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Key generalizations from beach morphodynamics

Dissipative beaches

1. High wave energies
2. Fine sand

Intermediate beaches

1. Intermediate wave energies
2. Medium sand

Reflective beaches

1. Low wave energies
2. Coarse sediment

Reflective Beach, Ystad (Photo: Brad Goodfellow)

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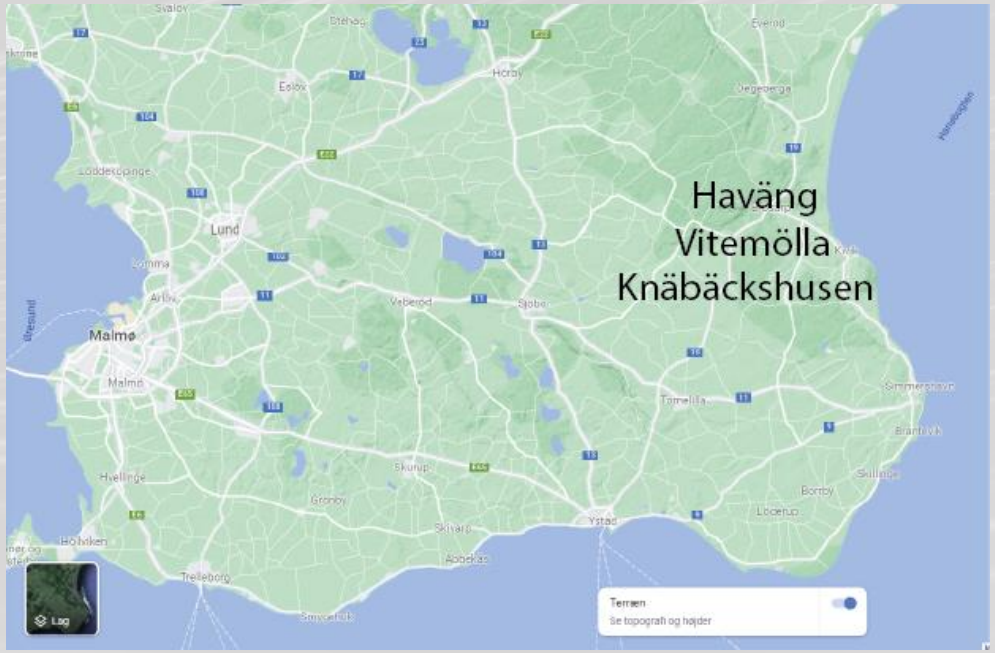
Where is it safe to swim?

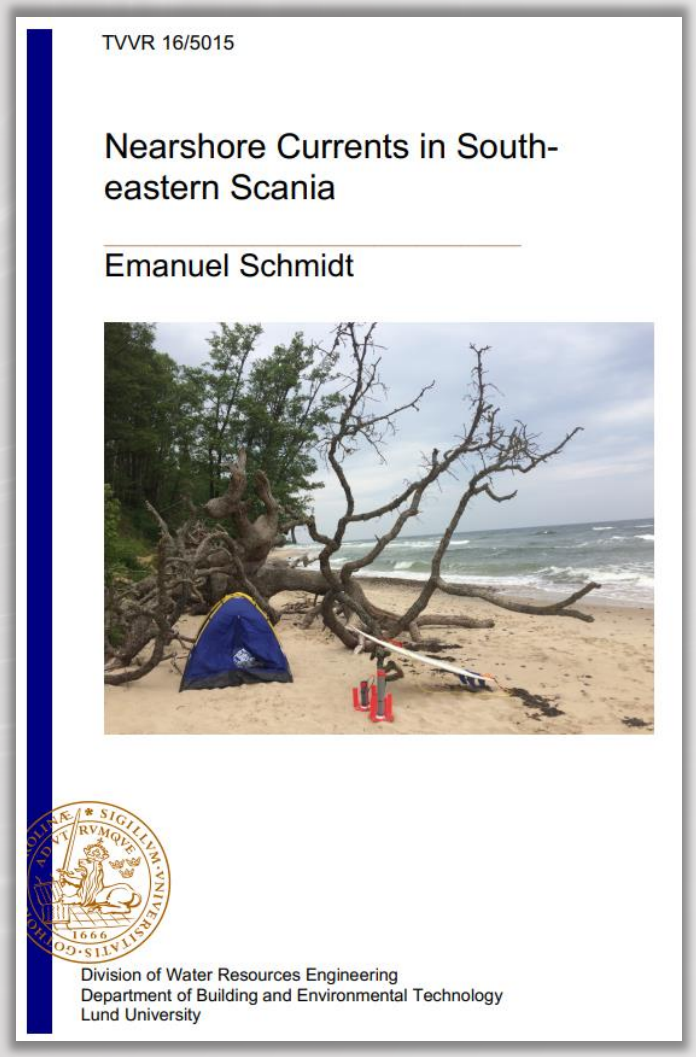
Rip currents in southern Sweden

Rip currents at Haväng, Vitemölla, Knäbäckshusen

https://lup.lub.lu.se/student-papers/search/publication/8904152

Swedish Sea Rescue Society (SSRS)




TVVR 16/5015

Nearshore Currents in South-eastern Scania

Emanuel Schmidt

Division of Water Resources Engineering
Department of Building and Environmental Technology
Lund University

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Summary

Educational video on rip currents

Rob Brander, University of NSW

https://www.youtube.com/watch?v=-hCZuYzNujI

Educational video on rip currents

Surf Life Saving Australia

https://www.youtube.com/watch?v=RJ4hcaJ91TY

Educational video on rip currents

Rip current science, usoceangov

https://www.youtube.com/watch?v=RJ4hcaJ91TY

Key point:

Reflect upon what you have learned

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