

Bore Soliton Splash: on maths of a splashing wave

Goals:

Seek external funding for experiment (NMC2011, dies-UT)

Suggestions?

Onno Bokhove, Applied Mathematics
with Wout Zweers & Anthony Thornton

<http://www.math.utwente.nl/~bokhove/>



Motivation: opening O&O-square

- Magnificent wave channel.



Motivation: soliton

- Channel smaller than narrow canals in Scotland.
- 1834: Scott Russel saw soliton when rapidly drawn narrow boat suddenly halted
- Reproduced soliton in laboratory channels, but scientists did not believe **strange solitary wave** amongst harmonic waves.
- Later reconciliation: e.g., equation by Dutch mathematicians Korteweg & DeVries in 1895, and Zabusky & Kruskal in 1965.

Motivation: soliton

- “Two sluice gates at end channel, near excavator. Level between gates higher -90cm- than in channel -41cm. After our signal 1st gate drawn up: 2 dominant waves run towards us ...”
- Together with chair of Student Union.





Origins

- 3 math profs ask mid Sept.: “Onno can you make **soliton in wave channel** at opening square?”
- Google: youtube soliton & double soliton
<http://www.youtube.com/watch?v=hfc3L9gAIs>
- Later: “Yes, but soliton is boring, because channel walls are opaque.”
- Something more **spectacular** ... but ...
- No further reaction on budget & time allotted?

Origins ...

- ... No further notice ...
- Yet we get going -with designer Wout Zweers.
- 1st test Sunday 19-09 in Roombeek art work.
- **It works!** http://www.youtube.com/watch?v=Of4_8RGGI80



Origins ...

- ... Others build heavy duty sluice gates...
- Test on location 27-09 (rain); go or no go?
- But it works again: high splash!
- **Sensitive dependence on height differences:**
 - 3) 41 & 90cm splash 3-3.5m
 - 4) 45 & 80cm 1.5m mini wave?
- 7 runs: run 5.

<http://www.youtube.com/watch?v=MADng1fqECY>

<http://www.youtube.com/watch?v=giRijBcPlmo&NR=1>

<http://www.woutzweers.nl/text%202010/2010%20soliton%20splash.html>



Origins ...

- Moment suprême 30 sept.



- Highest splash:
3.5-4m!

- Mission accomplished.

- Movie:
Prof.
Geurts



Surprising effects

- Run 2: 30-09 with 43 (before 41cm) vs. 90cm:















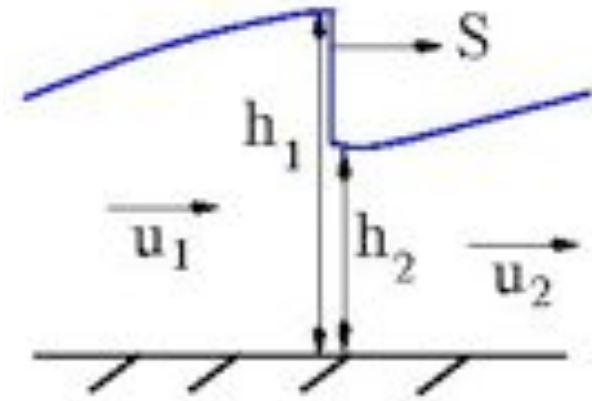
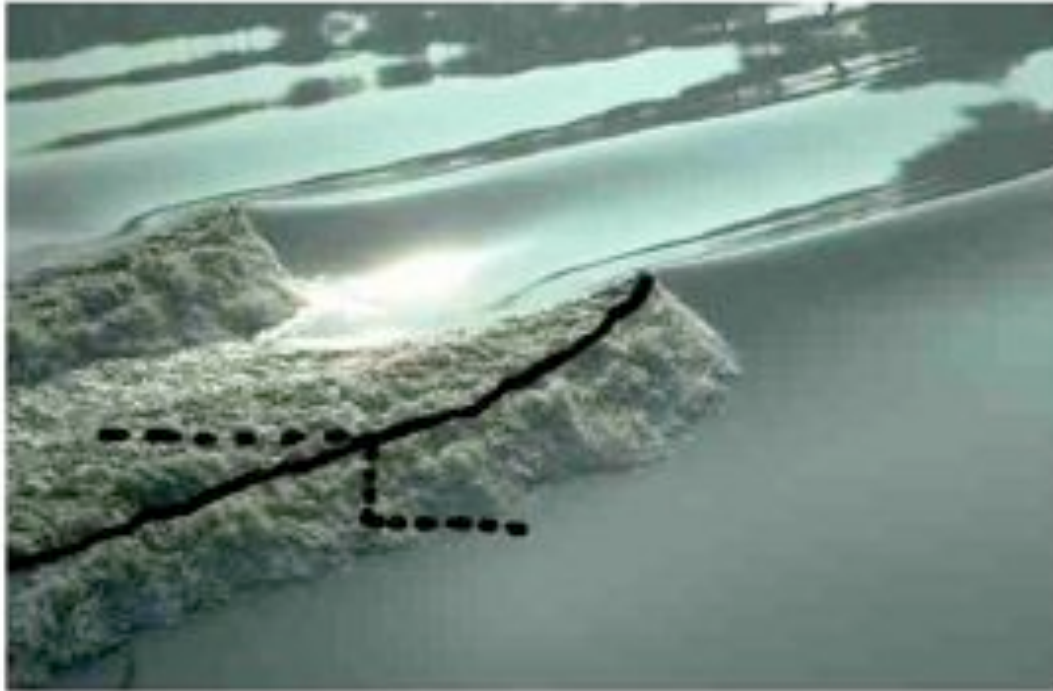
No breaking wave, i.e., **no bore!**

When (no) breaking wave?

- Start:
 - 90cm in sluice
 - 41cm in channel
 - breaking wave or **bore**:
- Start:
 - 90cm in sluice
 - 43cm in channel
 - no wave breaking
 - 2 **solitons**:



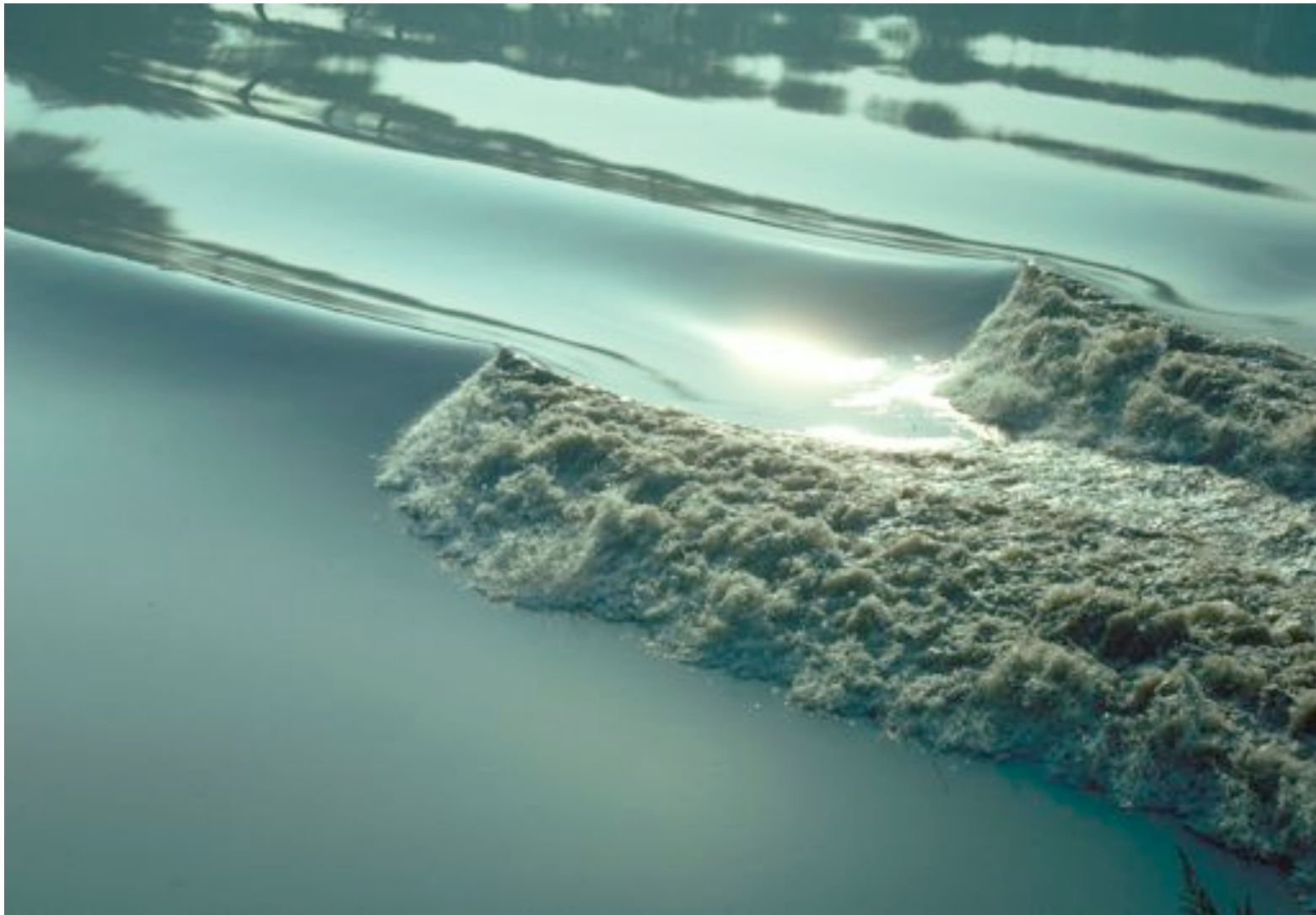
Intermezzo: what is a bore ...



- Speed of **bore/jump**:
$$S = u_1 + \sqrt{\frac{1}{2} g(h_1 + h_2) \frac{h_2}{h_1}}$$

Mathematical challenge

- Build simple model to **predict** when wave breaks, or not, or partially breaks (Severn Bore, photo Peregrine):



Relevance BSS-experiment?

- **Predict breaker line** at coast: sand transport in surf zone.



Relevance BSS-experiment ...

- **Applied maths** on coastal engineering of waves, sand and river flows.
- **Mathematical models** for coastal protection; Petten:



Conclusion



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Posters in the London Underground
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Waves are a source of delight. They also cause enormous destruction.
We need to understand how they form and how they propagate, and find ways to harness their energy safely.
Maths holds the key to this understanding.

$$-\frac{\partial A}{\partial t} + (c+A)\frac{\partial A}{\partial x} + \frac{\partial^2 A}{\partial x^2} = 0$$

maths makes waves

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Waves Photo: Howard Peregrine (Mathematics, Univ. of Bristol)

Questions to you!

- We seek **external funding** for renewable demonstrations at Dutch Math. Congress (NMC) 2011-UT?
- ... same for **dies** -UT.
- Funding for actual research with experiments and calculations of the **bore-soliton-splash**.
- **PR-deal** for firm easily envisioned ...: name branding, small demo model,
- **Suggestions?**

References

- Text: google Onno Bokhove <http://www.math.utwente.nl/~bokhove/>
- Images: <http://www.woutzweers.nl/text%202010/2010%20soliton%20splash.html>
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