

Copenhagen Port

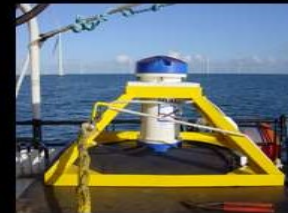
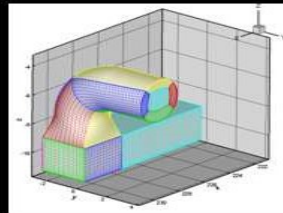
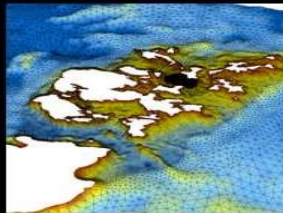
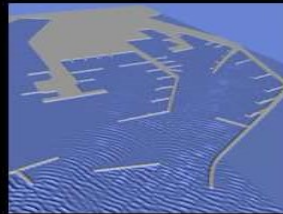
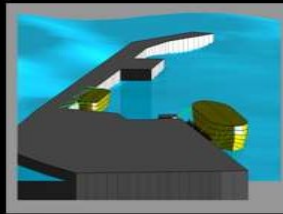
Dr. Ole Larsen
Director of Strategic Partnerships
Marine & Coastal
DHI



DHI: A wide range of marine competences



The DHI waterway



Laboratory tests

Numerical models

Field data

Strong people + “3-in-one” – successful solutions the DHI way !







Copenhagen Harbour - Nyhavn

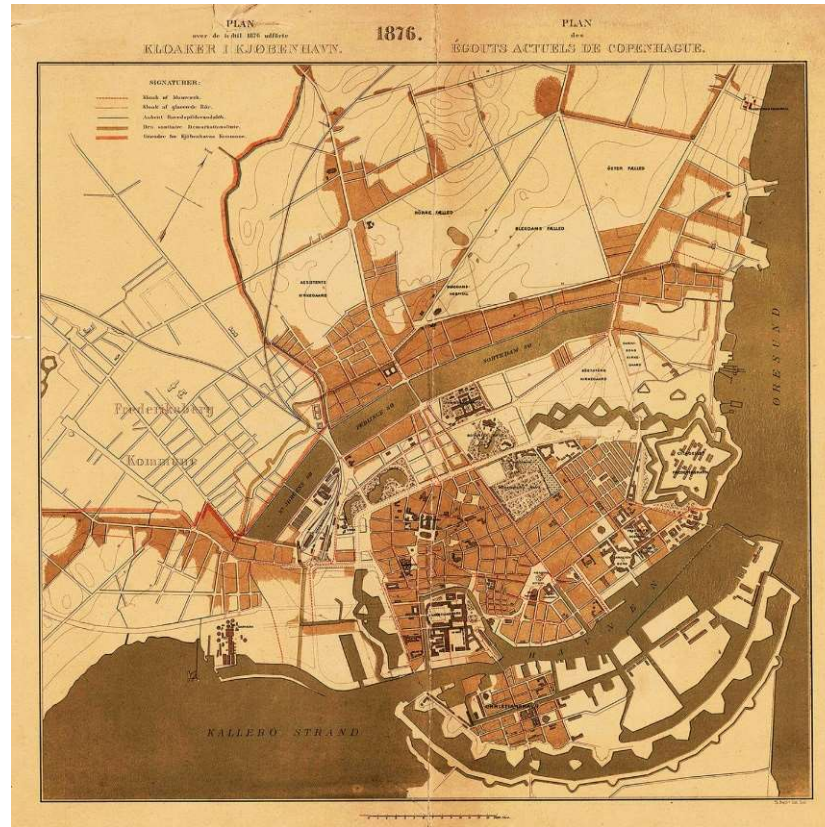


Copenhagen 1853 – last major cholera epidemic



Oldest sewer in Copenhagen (1859)

After the cholera epidemic in 1853 a sewer network was established



Copenhagen sewer
“network” anno 1870
– all mains leading
to the harbour

Early industrialization 1850-1900

- People moved from agriculture to industry Copenhagen was the centre. Population doubled within 30 years.
- With the same population density today – it would correspond to all Danes (6 mio) within the city limits!
- Insufficient sewers – the first sewer master plan 1897.



Bathing in Copenhagen Harbour (Apartments were without bath)

In 1953 it was forbidden to swim in the harbour due to poor water quality.



Soybean processing plant – last industry closed in 1991



Soybean processing used a mercury catalyst – in Copenhagen, we have almost 1 t Hg in the harbour sediments.

After 1980:

- Mid 1980 the commercial harbour moved out of the southern and inner harbour – giving space for new housing and recreational areas
- In 1991 the soybean processing closed – as the last factory.
- In 2002 the first harbour bath with the iconic red-white tower opened
- In 2013 the last commercial vessel M/S Trans Dania delivered its final load of paper to the paper island
- In 2015 fishing was allowed on 37 km of quays
- In 2018 CNN named Copenhagen the best bathing city of the world

The harbour bath



30 years achievements:

- Changing the city from an industrial harbour city to a service centre
- Change from a medieval city to a modern metropole

The people:

- Annual population growth: 1.7-3%
- Population is young: 60% < 40 years

The economy:

- Surplus of work: 119 jobs per 100 working citizens
- Economic growth: 1.9% p.a.



How did the Copenhagen history come through?

- Politicians formed clear vision
- Translation of vision into targets for authorities and utilities
- "Multiple accounting systems" to flow up on strategy
- Formation of the "Harbour and City company" to manage stateland (2007)
- Land development has generated the profits required for major infrastructure development
- Long-term plans with annual KPIs for utilities and city operations
- DHI expertise has been used to guide and prioritize development efforts

Health demands

- Keywords: Secure health
- *E.coli* and enterococci bacteria
- Heavy metals
 - in the water phase
 - by re-suspension
 - in the sediment

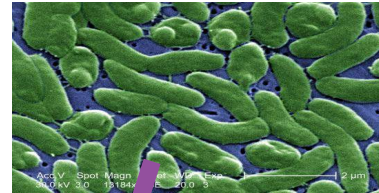


Bathing Water Directive

- *'...The purpose of this [the Bathing Water] Directive is to preserve, protect and improve the quality of the environment and to protect human health ..(article 1, section. 2)'*
- *"...Bathing waters are to be classified as 'sufficient/good/excellent... if - when subject to short-term pollution - adequate management measures are being taken, including surveillance, early warning systems and monitoring, with a view to preventing bathers' exposure, by means of a warning or, where necessary, a bathing prohibition (Annex II, sections 2, 3 and 4)*



**Indicator
bacteria**

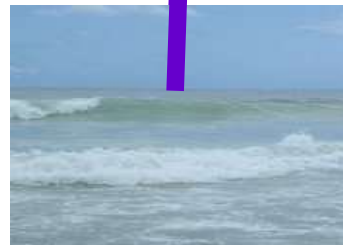


Vibrio

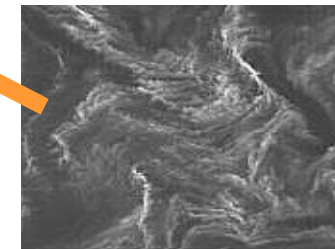


Other

**Algal
blooms**

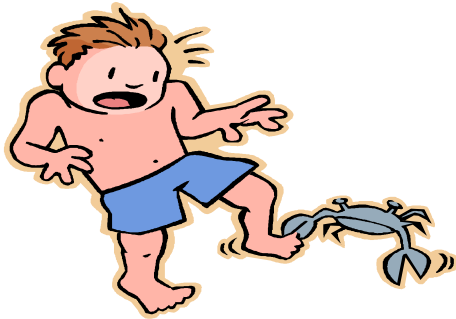


Waves

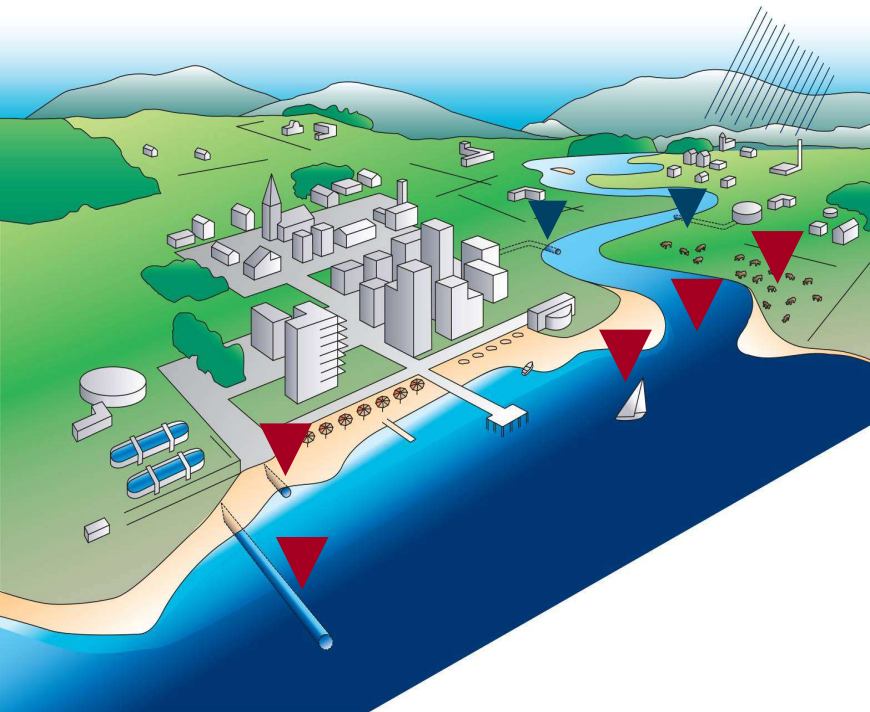


Currents

- ✓ **safe bathing water 24/7**
- ✓ **closing only when necessary**
- ✓ **quick information**
- ✓ **user-friendly information**



Short term pollution (< 72 hours)



- In Denmark most short term pollution originates from direct or indirect (through rivers) outlets from the sewer system or waste water treatment plants in connection with rain.
- In Sweden most short term pollution origins from the same events but from distributed sewer and rain water systems

Point Sources (Mapping)

WWTPs

- Two large-scale WWTPs (750.000 and 350.000 PE)

Combined sewer overflows (CSO)

- Both wastewater and urban run-off ("Stormwater")

Urban run-off

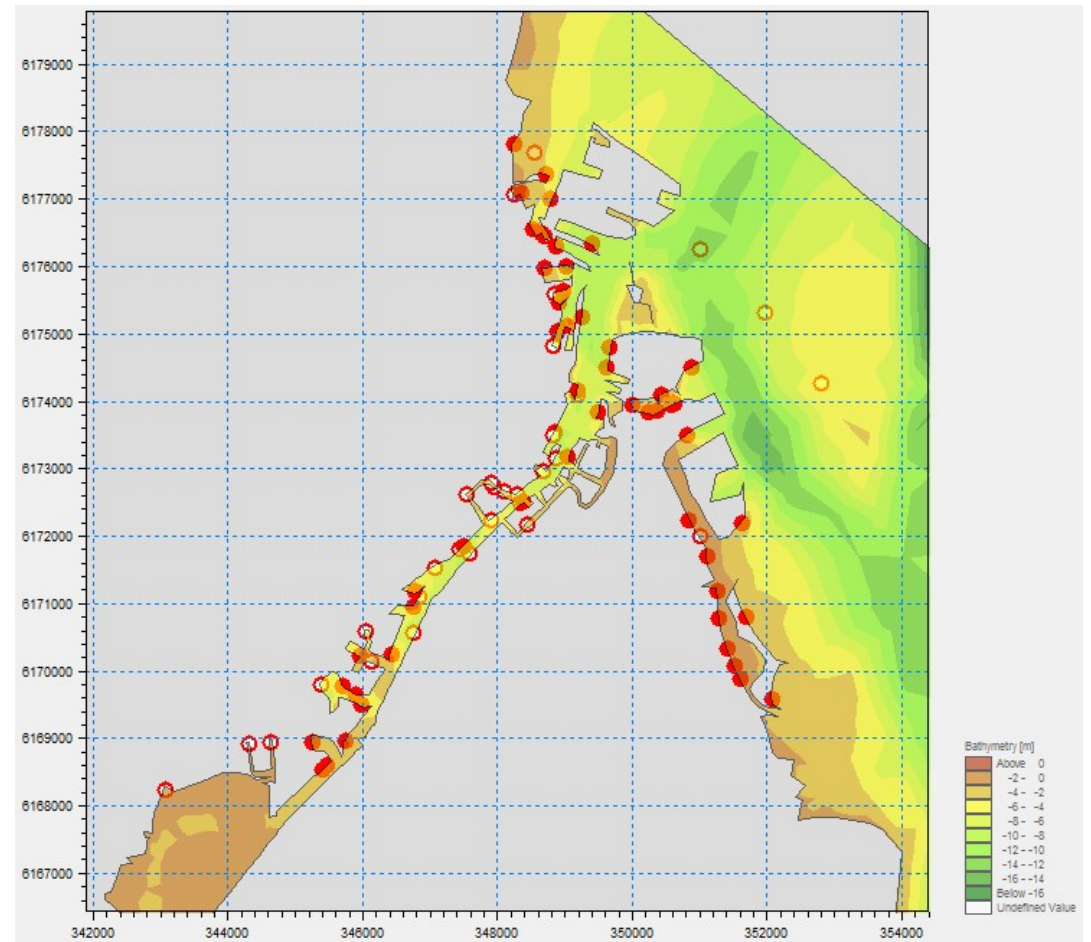
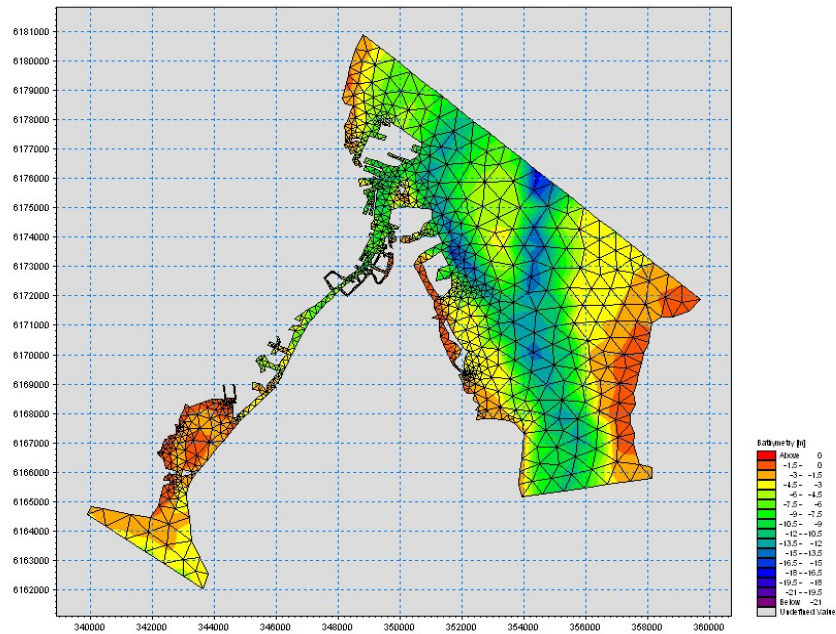
- Separate urban run-off ("Stormwater")

River with CSO + urban run-off – Sewer installation

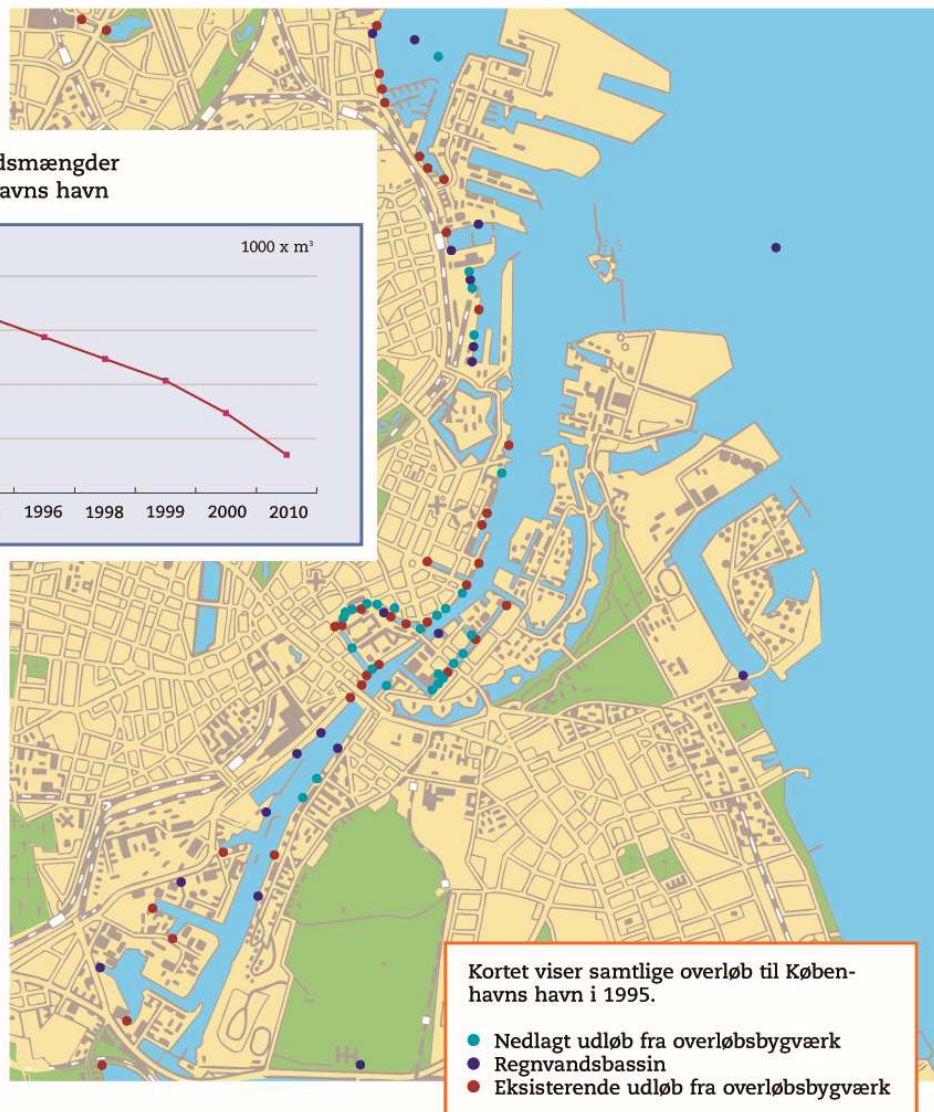
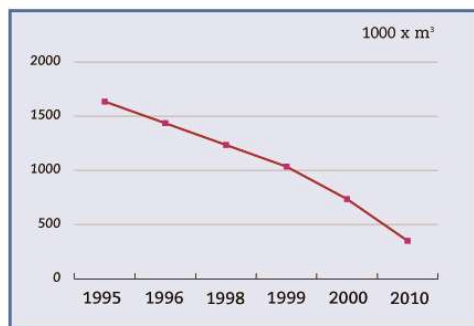
Direct industrial discharges to CPH Harbour



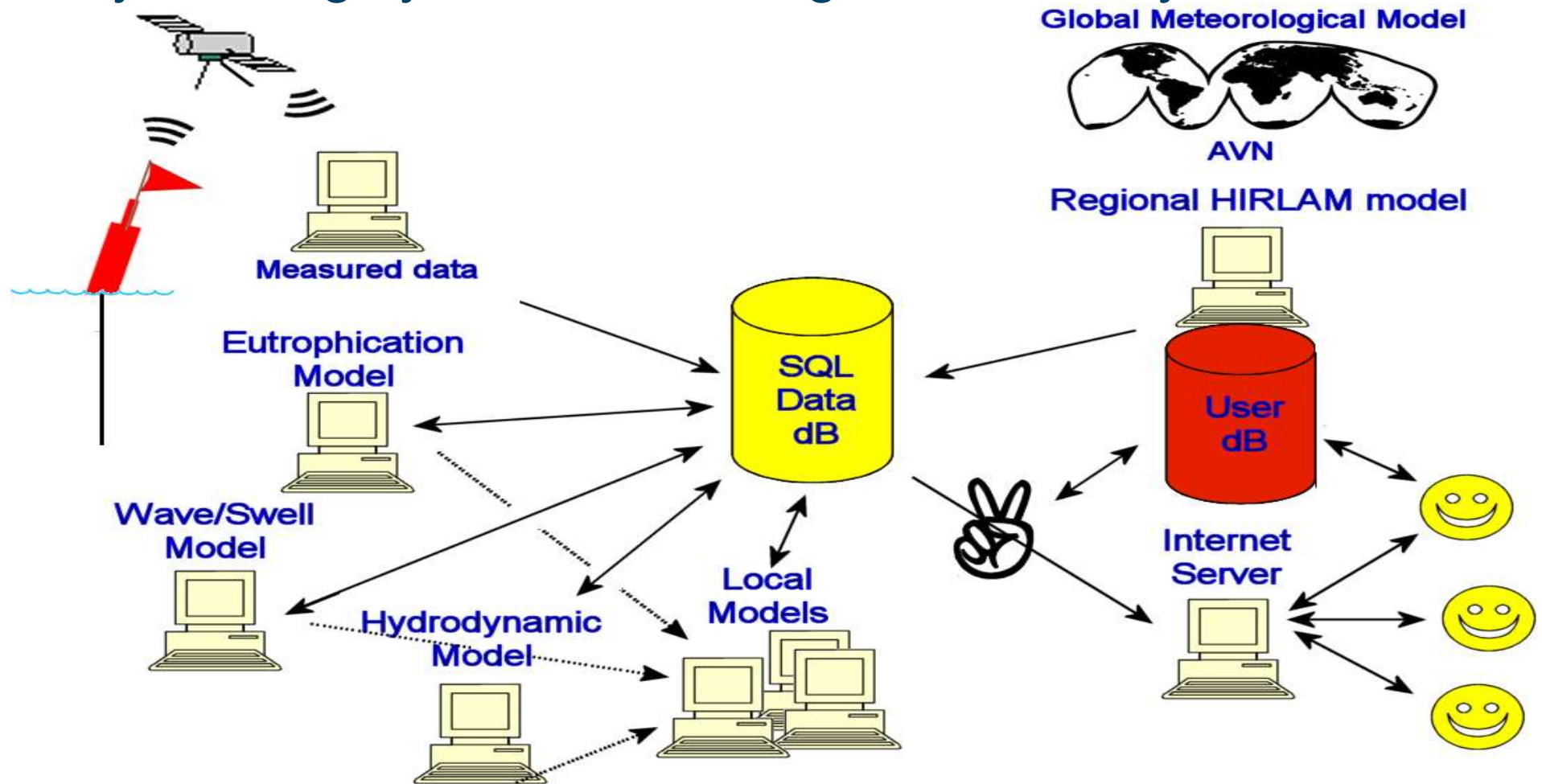
Point Sources

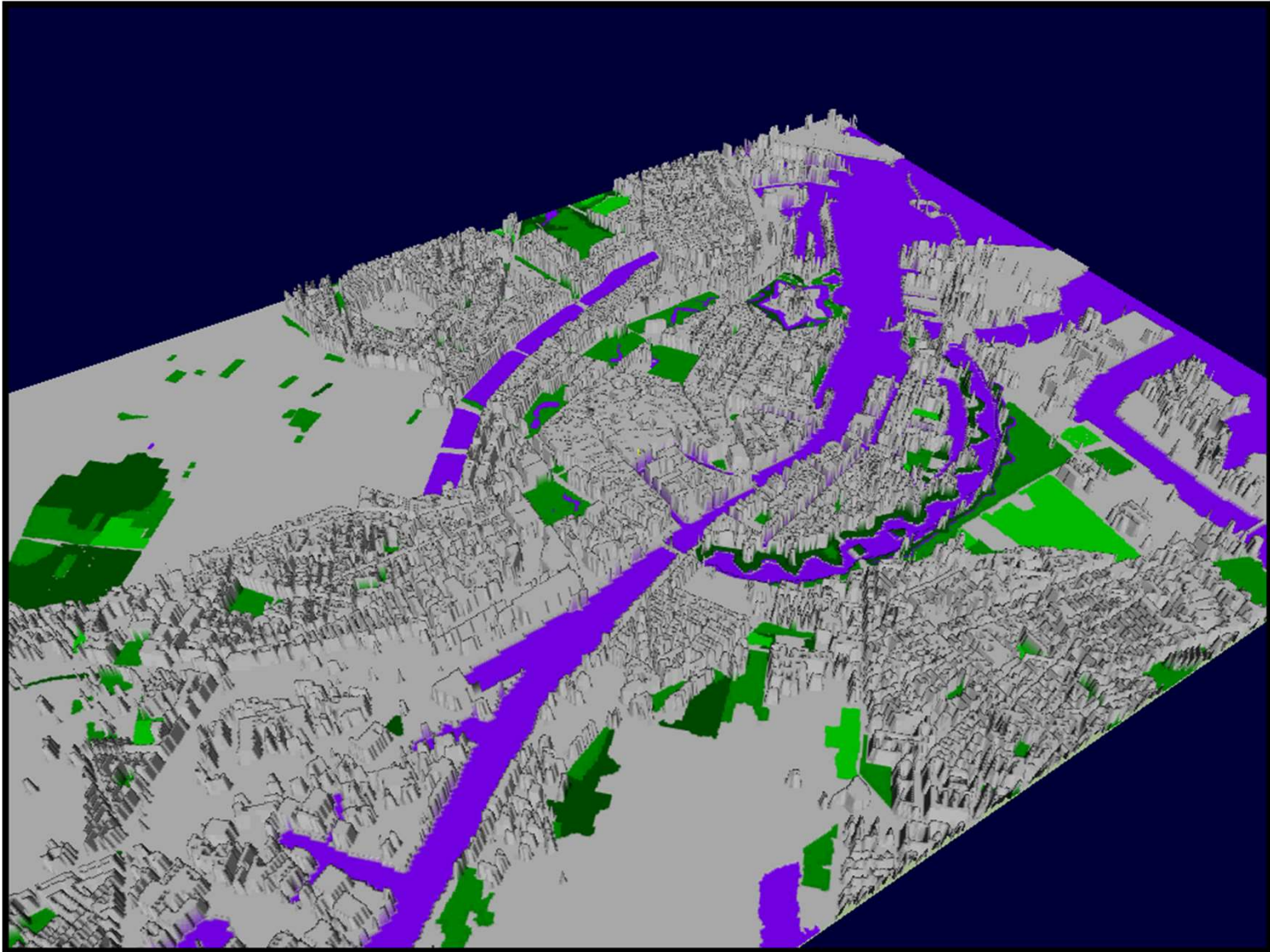


Spildevandsmængder til Københavns havn

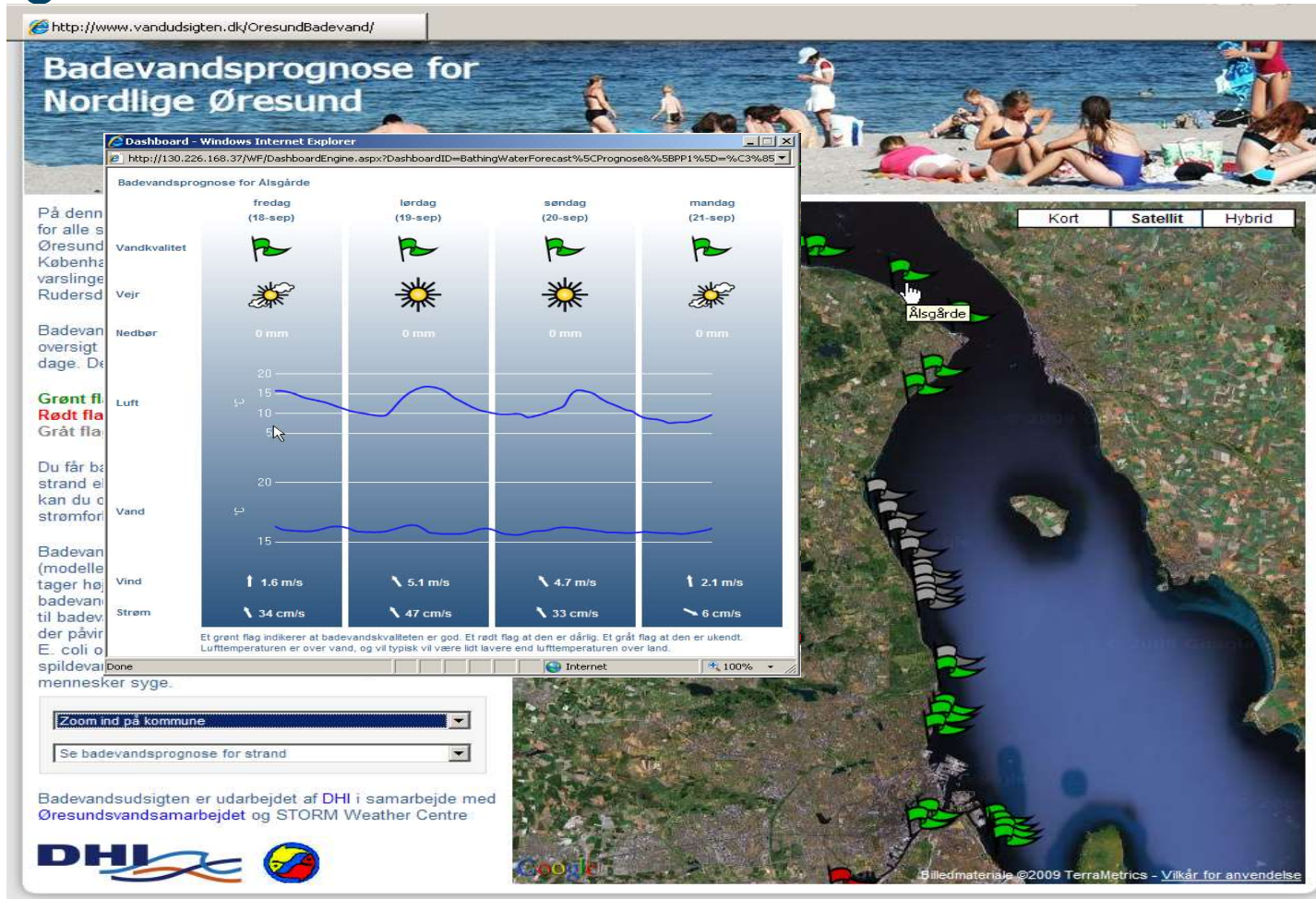


Early warning system for Bathing water Quality





Bathing water and the Public



..... And Smart Phones



Operational Bathing Water Forecasts

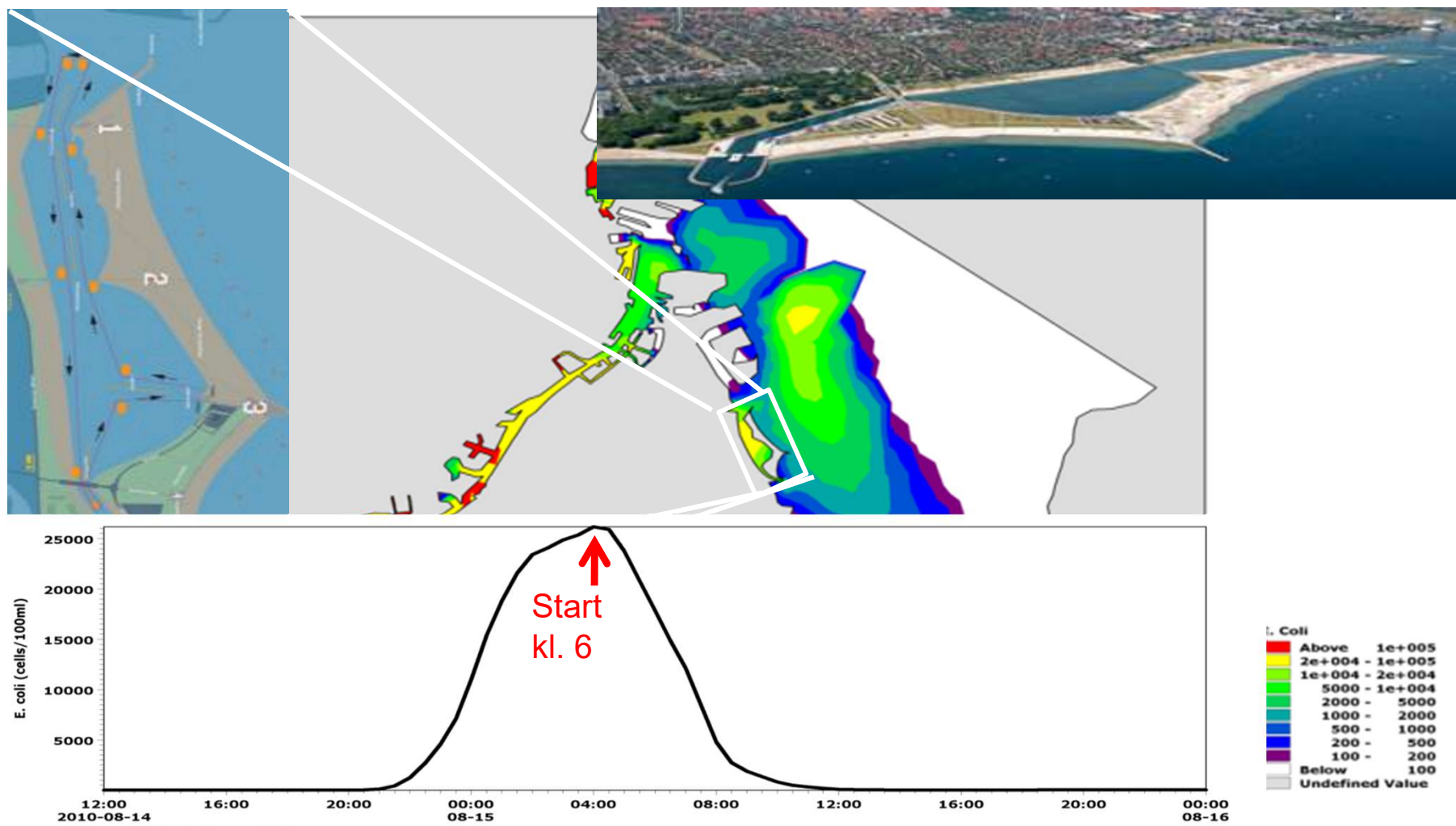
Example of application



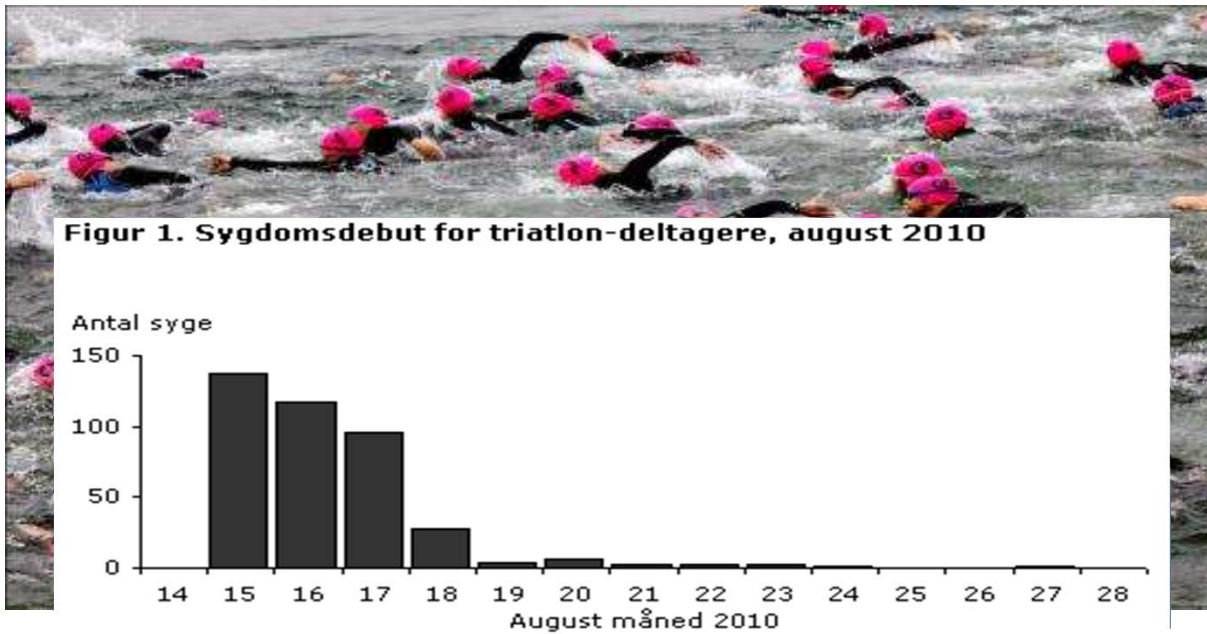
Extreme Rainfall event in Copenhagen 14. August



Use of Bathing Water forecast – Triathlon 15. August



Health Risk



In total 778 (59 %) answered the questionnaire send out by the SSI. Out of these 428 (55 %) confirmed symptoms of gastro-enteritis.

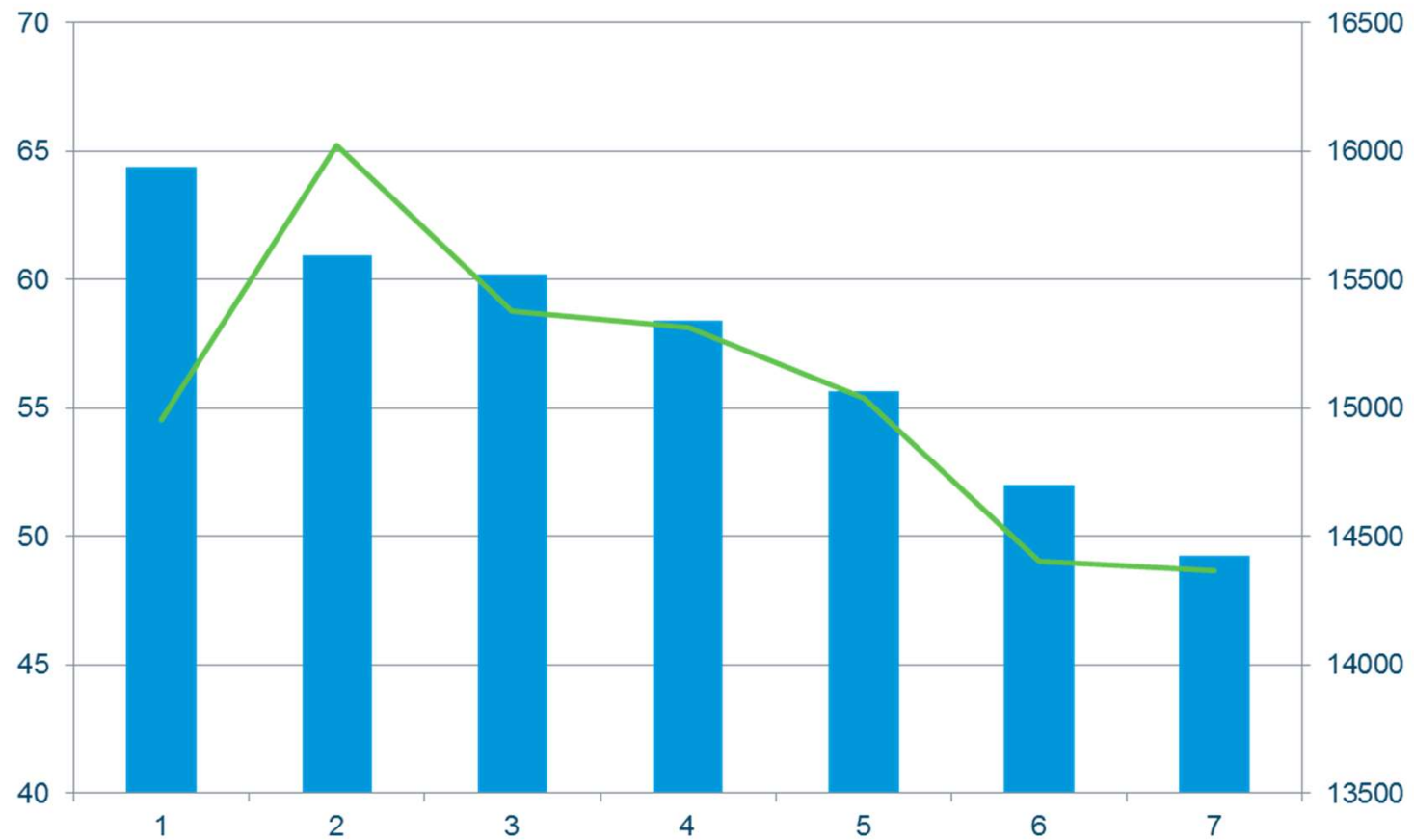
Ref.: SSI

Kilde: EPI-NYT 42/43, 2010

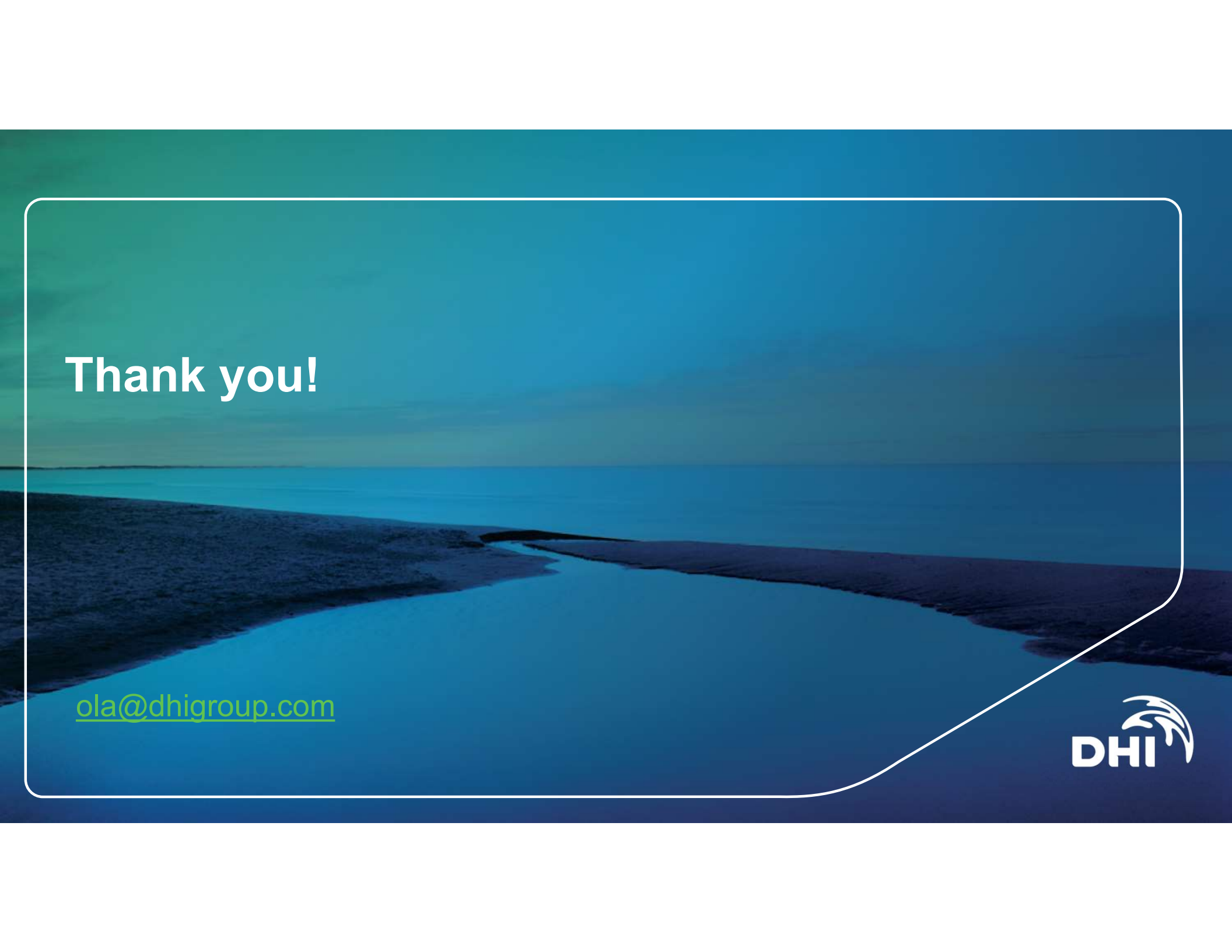
..... a lot of debate, and people getting sick, ...

but the Model was spot on

Health Risk?







Thank you!

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