TALLINN UNIVERSITY OF TECHNOLOGY

TAL TECH

Tallinn University of Technology (1918)

- Public university
- Second biggest university in Estonia
- Only technical university in Estonia
- Located in the capital of Estonia – Tallinn
- Fully accredited programs
- Modern facilities and computer labs, free wifi
- Ranked No ~500 (QS)

TUT in numbers

- Established 1918
- 4 faculties
- Estonian Maritime Academy
- 20 departments
- Two regional colleges
- 3 languages: Estonian, Russian and English
- 11 200 students
- From 94 countries
- 1840 employees
- 68000 alumni

School of Science
Department of Cybernetics

- ... is a research and development institution, conducting multidisciplinary research:
  - Mechanics
  - Physics
  - Material science
  - Theoretical and applied mathematics
  - Wave engineering
  - Systems biology

Wave Engineering Laboratory

Currently

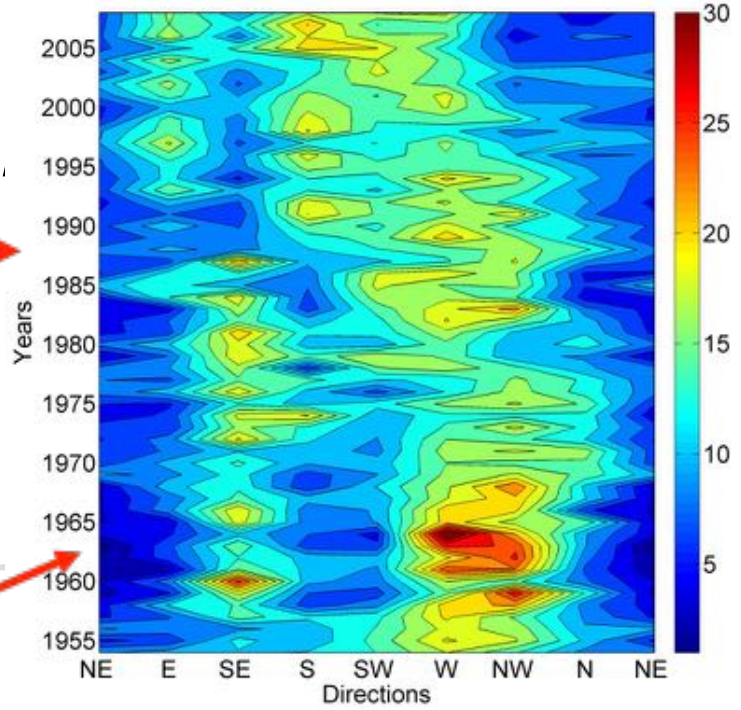
- 3 senior scientists
- 6 scientists with PhD
- 3 PhD students
- 2 guest PhD students

Since 2009

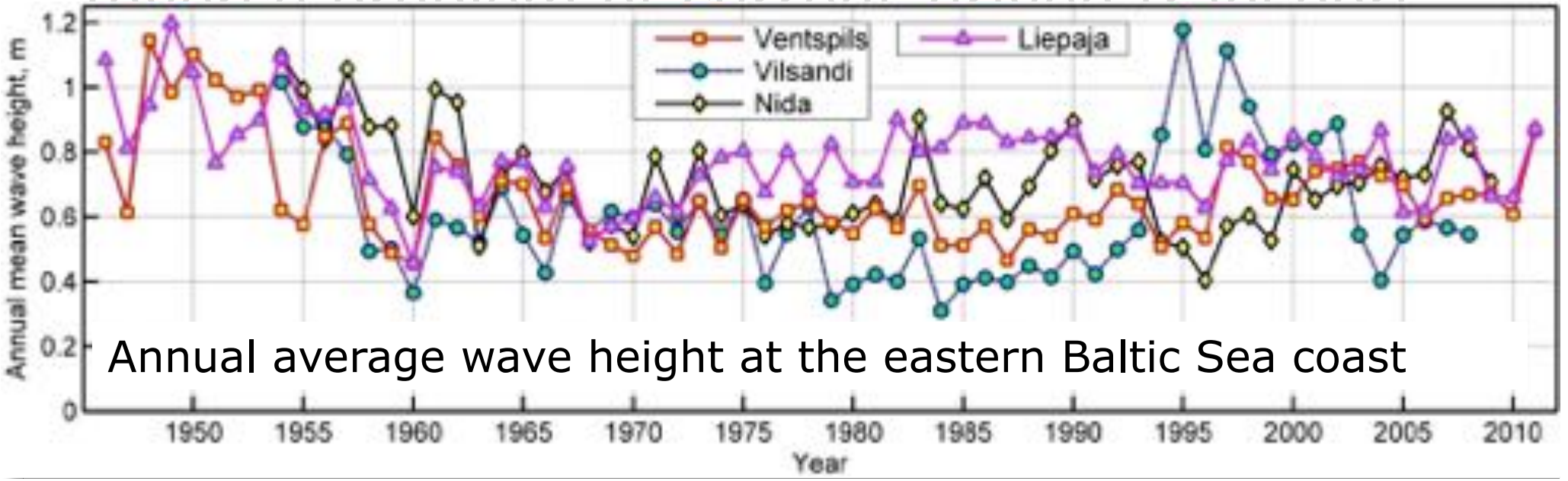
- 13 PhD promotions
- 9 MSc promotions
  - 7 in Earth sciences
  - 1 in civil engineering
  - 1 in environm. eng.
- 130 ISI-publications
- 2 books (Springer)
- Plinius Medal 2010
- Young sci. of the year 2010
- Sci. of the year TUT 2011
- Best sci. popularisator in Estonia 2011
- National Research Award 2012/2013 in engineering

Our focus: Waves shaping the coast

- Waves offshore and nearshore
  - Long waves (*runup, overtopping,*
  - Wave climate, climate changes
  - Wave-coast interactions
- Marine hazards
  - Tsunami, e
  - Monster wa
  - Solitons &
- Inverse problem of current-driven transport



Major observed changes in the wave approach direction in the eastern Gulf of Finland in 1954-2007 (Soomere et al. 2010)



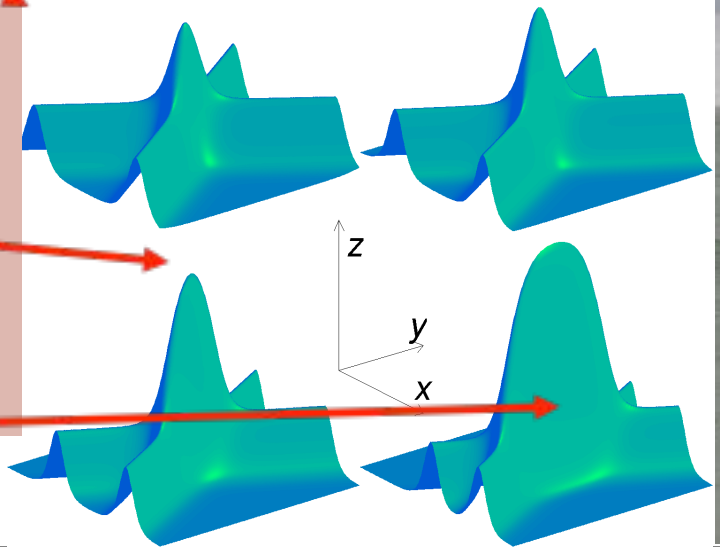
Annual average wave height at the eastern Baltic Sea coast

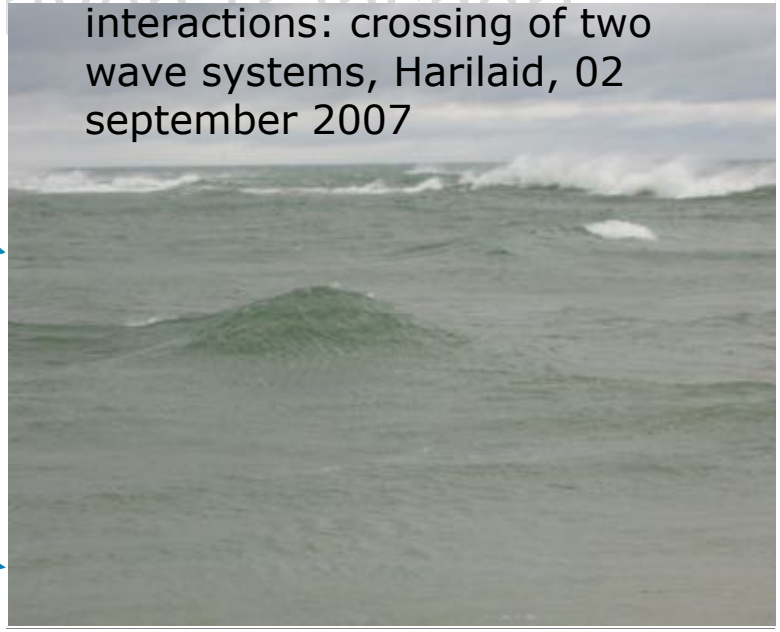
Input to management: Marine and coastal hazards

- Waves offshore and nearsho
  - Long waves (*runup, overtoppin*
  - Wave climate, climate changes
  - Wave-coast interactions
- Marine hazards
  - Tsunami, extreme storms
  - Monster waves, ship waves, internal waves
  - Solitons & interactions

Inverse problem of current-driven transport

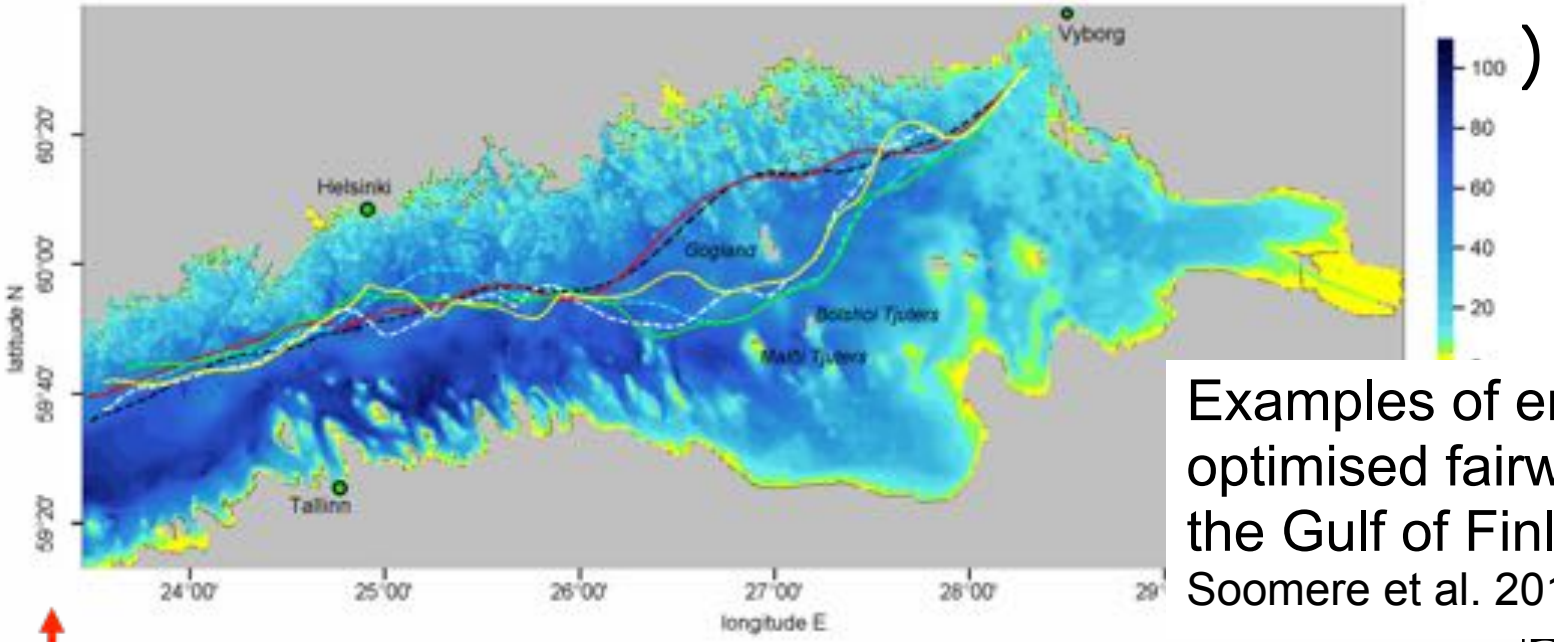
Soliton interactions as a source of long-living monster waves: 4-fold increase in wave height; 8-fold increase in steepness





Shallow-water soliton interactions: crossing of two wave systems, Harilaid, 02 september 2007

Input to offshore engineering: Technologies for environmental management & fairway design



)

Examples of environmentally optimised fairway designs for the Gulf of Finland (Andrejev, Soomere et al. 2011)

...ansport

Lagrangian transport
Optimal fairways
Maritime spatial planning
Preventive methods for coastal protection

Reducing the consequences of offshore disasters by smart adjusting the location of human activities so that the pollution will not hit the vulnerable regions

Input to CUPAGIS

Wave Engineering Laboratory:
Applications of mathematical and remote sensing methods incl. satellite and airborne (laser scanning) data in agriculture sector.

Department of Geology, School of Science:
Active laboratories on biogeochemistry, radiocarbon dating, micropalaeontology, hydrogeology, and applied geology

Department of Civil Engineering and Architecture, School of Engineering:
Geodesy, high-resolution imaging and terrain mapping (GIS-based) methods

Coastal processes and environmental management

- *Goals*: mastering of knowledge and experience on coastal meteorology, hydrodynamics of waves and currents, sediment transport, coastal geomorphology and sustainable management of the coastal zone
- *Outcome*:
  - Knowledge of rules governing the evolution of beaches
  - Ability to estimate the reasons and consequences of both natural variability and human interventions in the coastal zone
  - Experience in measurements and analysis of factors impacting the coastal zone; incl. extreme conditions
  - Experience in methods of integrated coastal zone management

[76 contact hours and 52 hours student workload]

Environmental mathematic modeling for wave dynamics

- *Goals*: to give knowledge about basics of linear wave theory in the framework of surface waves and about methods of forecast and analysis of realistic wave fields and wave-driven hazards in the coastal zone
- *Outcome*:
  - Experience in the basics of linear wave theory and ability to use it for solving engineering problems
  - Understanding of the scope of validity of classical theories and appraoches
  - Ability to estimate parameters of wave fields in particular coastal sections and the importance of the potential impact of waves on coastal engineering structures

[50 contact hours and 50 hours student workload]

Preventive methods for coastal environmental protection

- *Goals*: to give knowledge about investigating ocean currents by use of experiments and numerical models, including the basic physical and numerical components of such models, and how such models can be used as basis for prediction of transport patterns
- *Outcome*:
  - Basic understanding of the physical and numerical components of an ocean circulation model
  - Experience in use of numerical modeling of transport based on pre-existing ocean model data
  - Experience in extraction of key transport properties from experimental data

[50 contact hours and 50 hours student workload]