

Estonian Aquatic Science: from Process Studies to Applied Research Supporting Ecosystem-Based Management

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watershed – rivers – lakes - sea

Department of Environmental Engineering I

Watersheds

- National **reference chemical laboratory** of rivers and coastal waters
- **Modelling** of nutrient leaching from watershed areas
- **Agricultural** nutrient run-off, investigations of the runoff processes
- **Nutrient transformation** in system: plot area, field, small watershed, river



Tallinn University of Technology

Department of Environmental Engineering II



Rivers

- Physical-chemical **monitoring** of rivers
- Typology and **classification** of rivers
- Surface **water quality**: spatial and temporal variability of water quality indicators
- **Nutrient load** and effects, eutrophication
- Integrated water **management**

Department of Environmental Engineering III



- **Climate change** impacts on the hydrological regime of rivers and quantity and quality of water bodies
- Water management planning for **transboundary waterbodies**
- Strategies for sustainable **land management**, including coastal zones
- **Sludge** handling and re-use



Aquatic research at

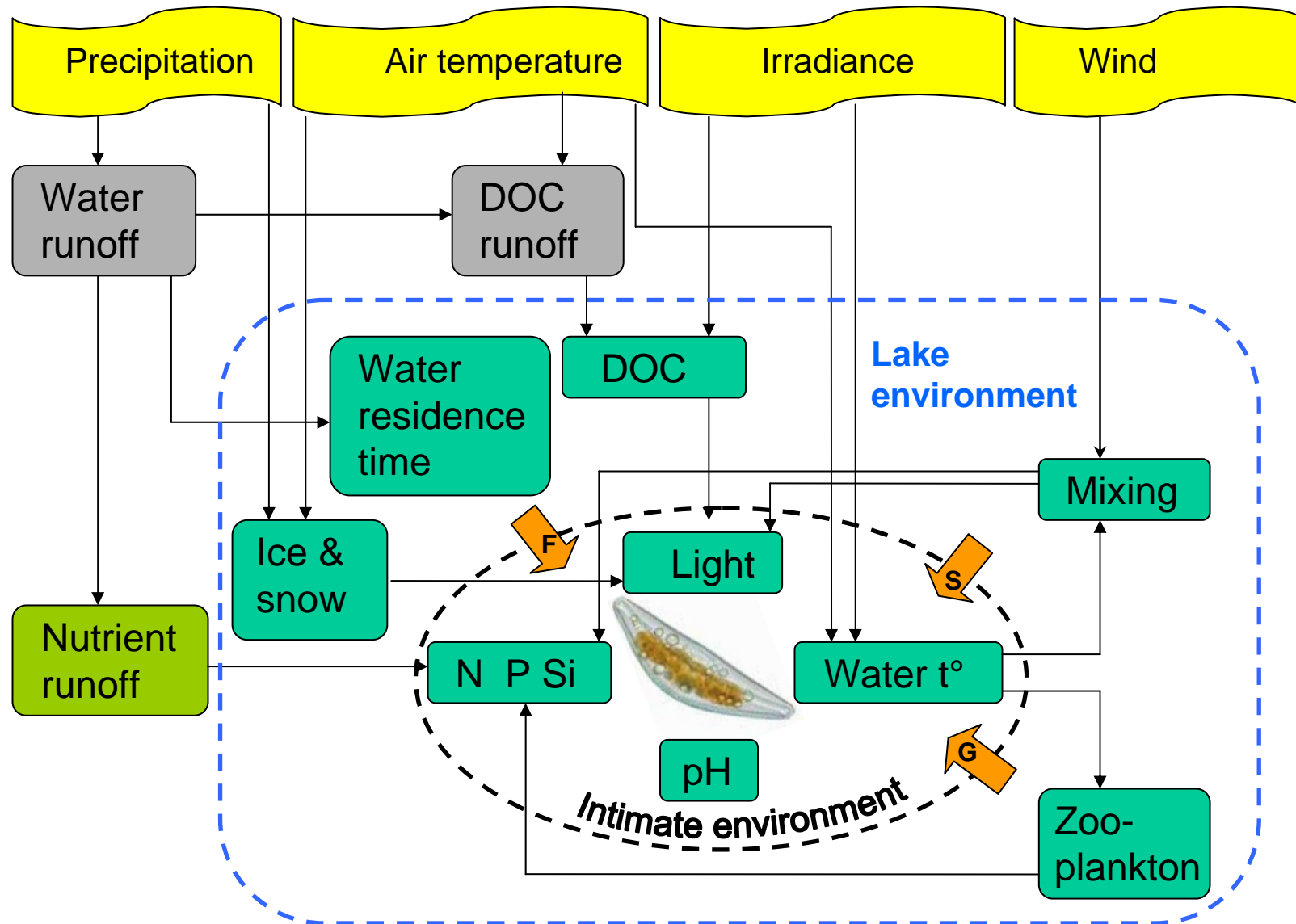
Estonian University of Life Sciences (EMU)

- **Three institutions:** Centre for Limnology (65 employees; www.limnos.ee), Department of Aquaculture (12; <http://www.eau.ee/~lki/kalakasv/>), Department of Water Management (15; <http://mi.emu.ee/180640>)
- **Topics covered:** ecology of inland water bodies, hydrobiology, protection of habitats, monitoring, environmental impact assessment, aquaculture, hydrology, water engineering, land reclamation, waste management, fish physiology and genetics

Lake investigations. Core grants:

- **"Impact of climatic change on shallow lake ecosystems"**
(Principal Tiina Nõges)
- **"Formation and changes of the biological diversity under the human impact in different lake types"** (Ingmar Ott)
- **"Benthic-pelagic interactions and stability of the ecosystem in large shallow lakes"** (Küllli Kangur)

Environmental factors controlling lake phytoplankton



Lake investigations. Applied research.

- Intercalibration of borders of **ecological quality classes** in Central/Baltic GIG of EU Member States. Cooperation based on WFD.
- Monitoring of inland water bodies and cooperation on international **design of monitoring** based on WFD
- Restoration of water bodies
- Fishery of lakes

Aquatic research at University of Tartu (UT)

Estonian Marine Institute

Main fields of research are:

- Biology and ecology of freshwater and **marine fish** populations.
- **Long-term dynamics** of Baltic Sea ecosystem and basic ecosystem mechanisms behind it.
- The effect of temporal and spatial variability of **coastal processes** on the biological and functional diversity in the NE Baltic Sea.
- **Optics and remote sensing** of coastal and inland waters.
- **Mathematical modelling** of the Baltic Sea and Estonian large lakes ecosystems and composing of the operational forecasting models.
- Effect of aquatic **invasive species** on coastal ecosystems of NE Baltic Sea.
- Effect of human induced **eutrophication** processes on coastal ecosystems of the Baltic Sea.

Research related to Habitat Directive

EU Life project: Marine Protected Areas in the Eastern Baltic Sea

Objectives:



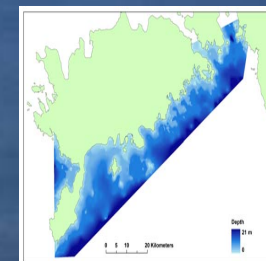
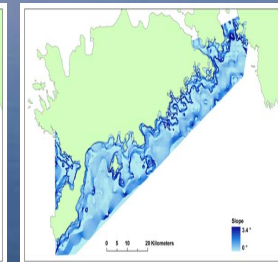
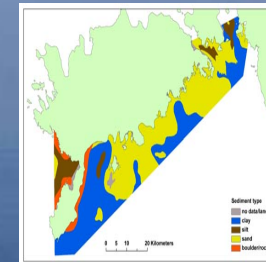
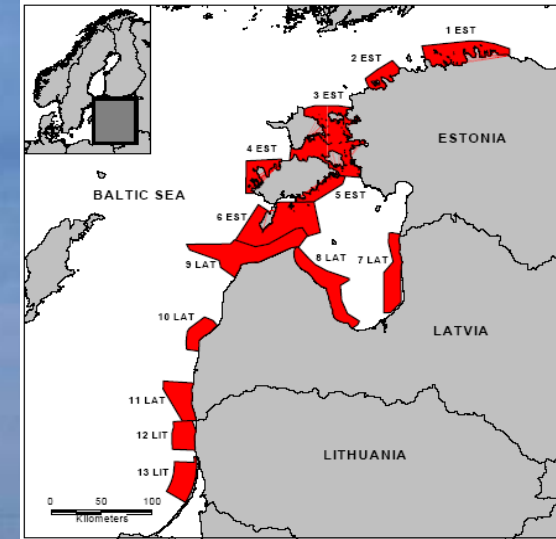
Completing the **establishment of Natura 2000** in the marine territories of Estonia, Latvia and Lithuania (site selection, designation, protection rules and management plans)

Assessing and reducing the **impact of fishery by-catch** on target species.

Assessing **other threats** to marine Natura 2000 sites (e.g. caused by constructions/dredging and dumping, pollution)

Increasing public and stakeholder **awareness** on Natura 2000, MPAs and biodiversity in general in Estonia, Latvia, Lithuania and Russia.

Promoting transboundary **networking and capacity building** on marine protected areas between the Baltic States, other EU Member States and Russia.



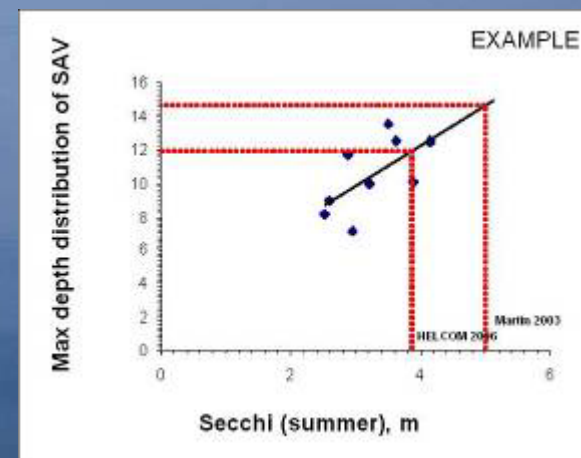
Research related to implementig of EU WFD

Establishment of **reference conditions** for different water quality elements (SAV, Phytoplankton, Macrozoobenthos) in coastal waters.

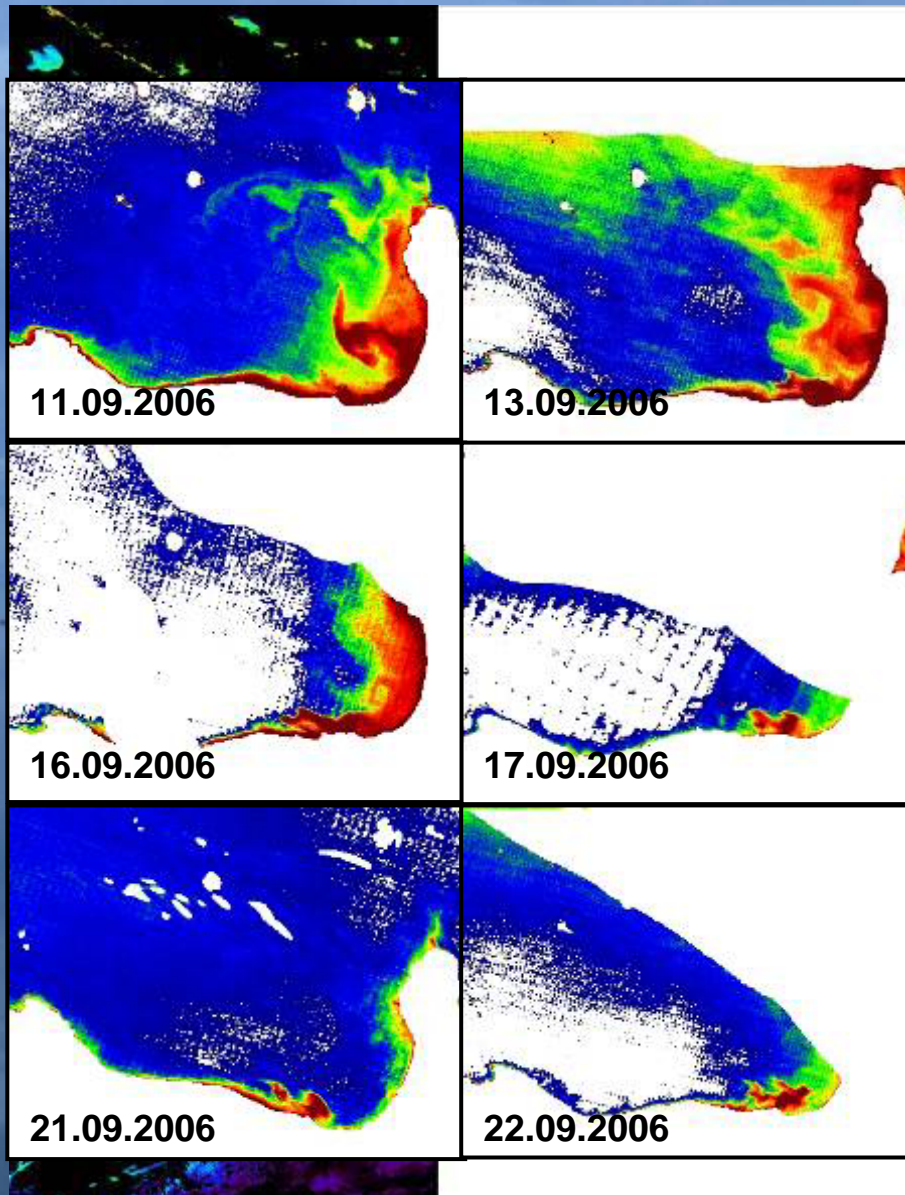
Development of **water quality classification** system for coastal waters including principles of class boundary setting.

Intercalibration of developed classification systems and refence conditions with other countries sharing similar coastal conditions (types).

Development of **new monitoring techniques** and strategies for improvement of spatial coverage and temporal resolution for coastal waterbodies.



Remote Sensing in Estonian Marine Institute



- * Developing remote sensing algorithms for coastal and inland waters
- * Quantitative mapping of cyanobacterial blooms
- * Mapping of shallow water benthic habitat (including coral reefs and seagrass beds)
- * Role of lakes in global carbon cycle
- Operative monitoring of coastal waters

Additional research fields:

Bio-optical modelling, studies on optical water properties, primary production and underwater light field



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TALLINNA TEHNIKAÜLIKOOL
TALLINN UNIVERSITY OF TECHNOLOGY



Aquatic research at Tallinn University of Technology (TUT) Marine Systems Institute

Main fields of research are:

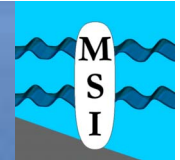
Basic research: Baltic Sea water and matter exchange processes

- basin-wide and coastal-offshore exchange processes in the NE water cycle loop;
- atmosphere-ocean interaction and marine forecasts;
- dynamics of coastal system, including suspended matter;
- processes controlling the estuarine pelagic ecosystem response.

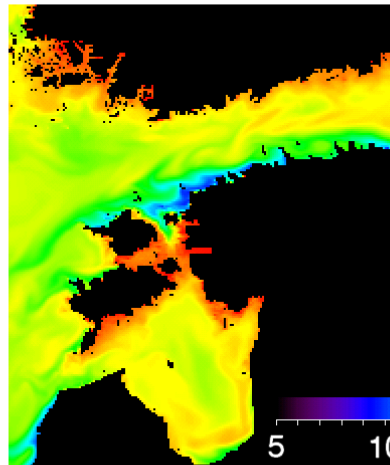
Applied research:

- operational oceanography (high-res observing systems, forecast models) ← GMES, EuroGOOS, BOOS etc
- impact studies ← industry
- observation technology

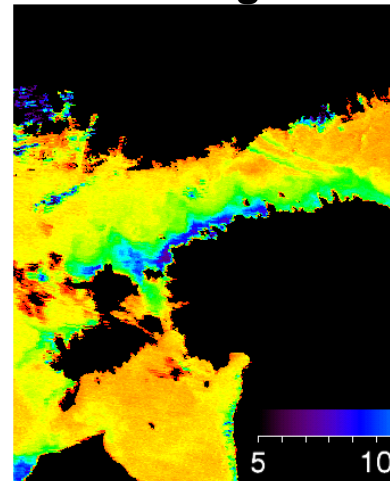
Upwelling effects on the nutrient cycle



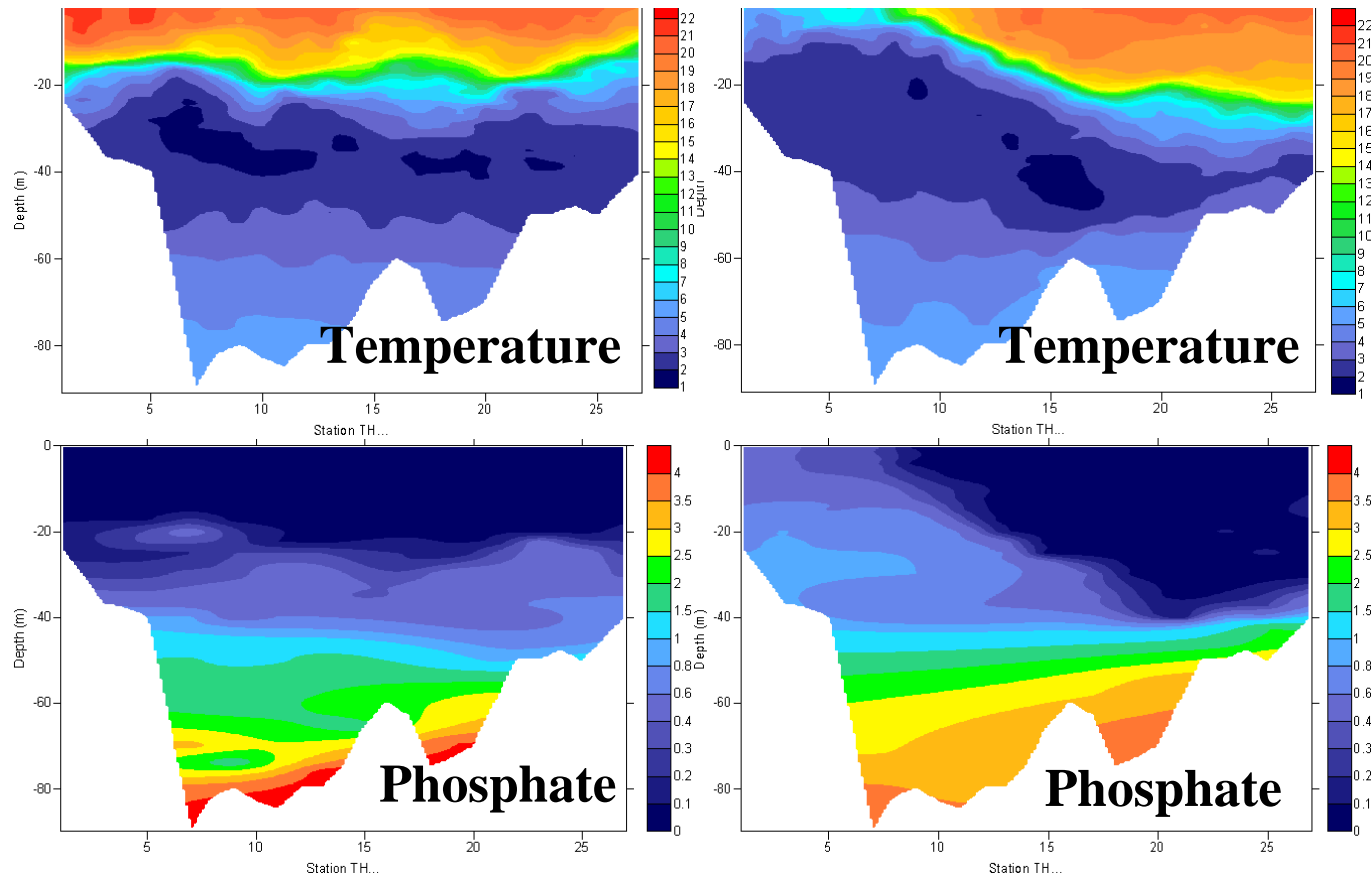
HIROMB model forecast



MODIS image



Before upwelling 11.07.2006 During upwelling 8.08.2006

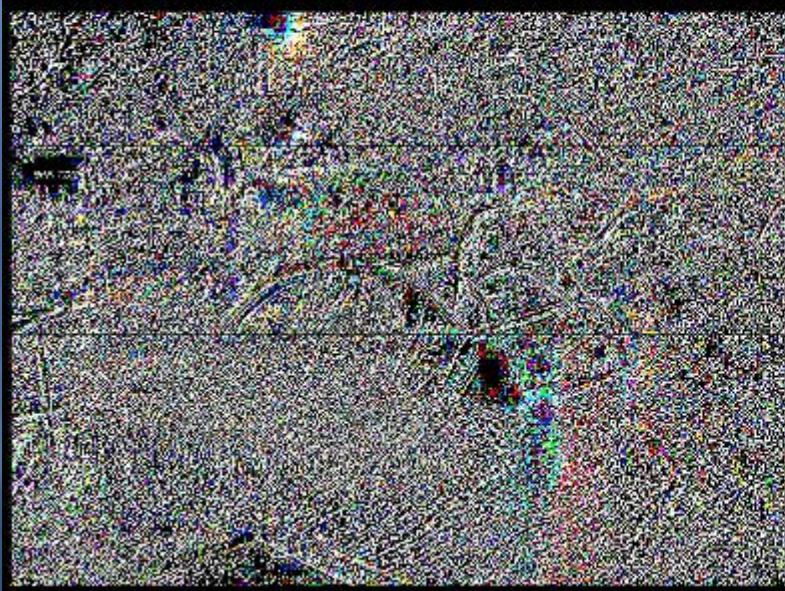
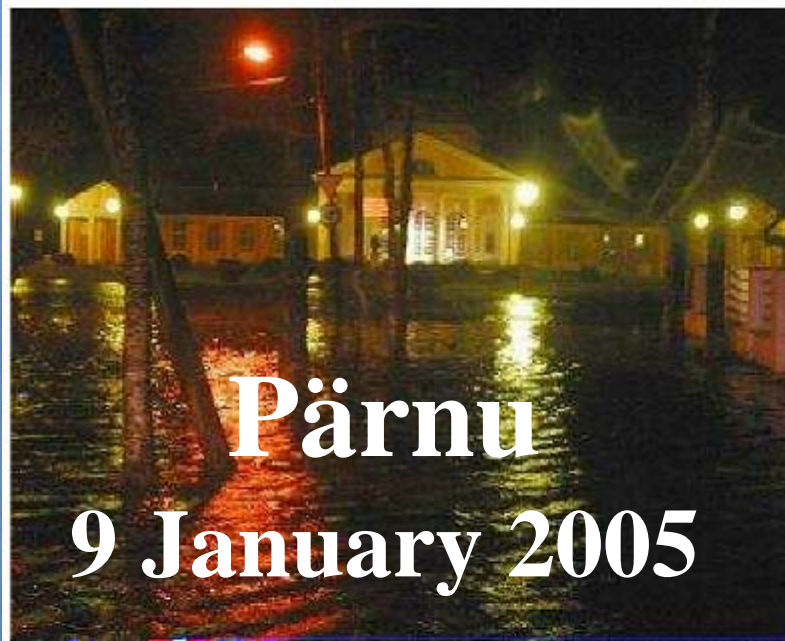


0,3-0,4 $\mu\text{mol/l}$ – 20 m layer – 20 km coastal zone – 100 km long

**Vertical flux estimate – 400-600 tons of P,
equals to ca 1 month riverine load**

Urmas Lips

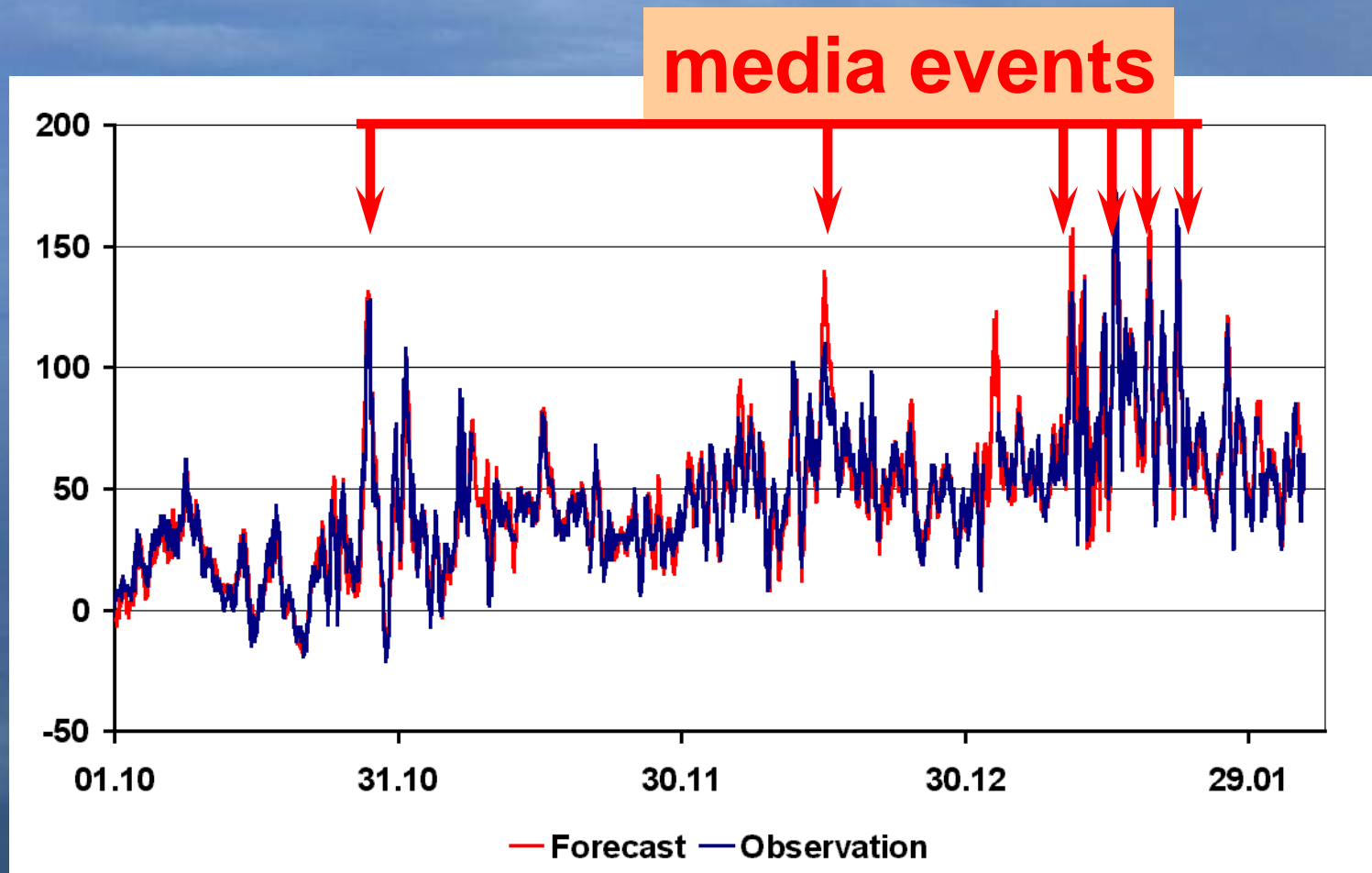
Need for operational oceanography



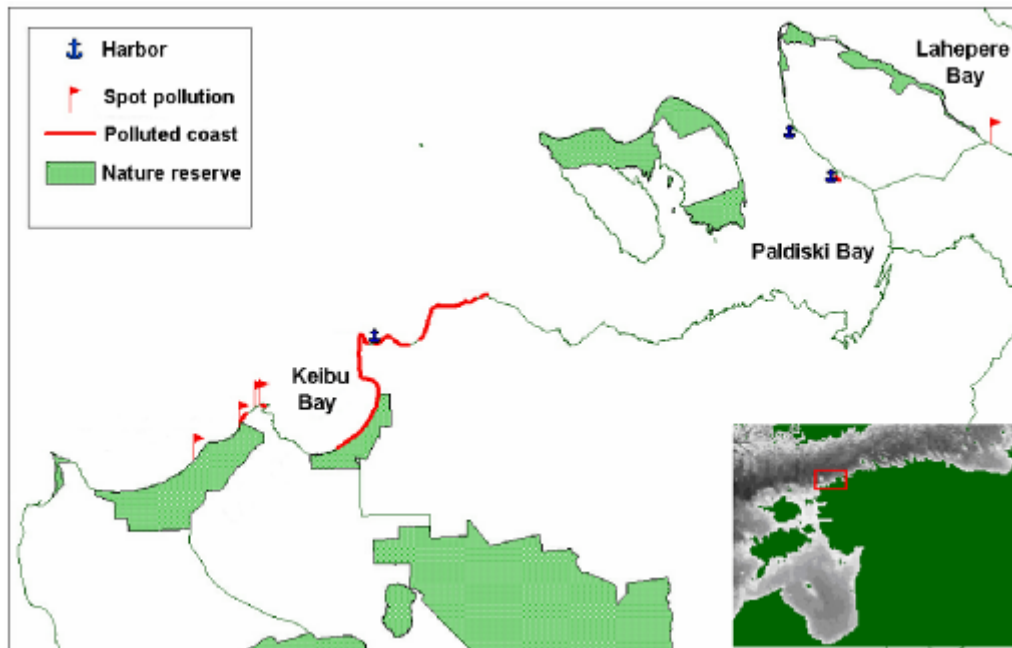
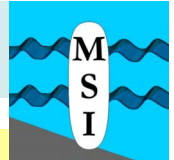
Operational oceanography in practice



Observed and 24h forecasted sea levels (cm) in Pärnu during the stormy period from 01.10.2006 to 03.02.2007



Recent marine oil pollution events, 28 January 2006



massive oil pollution found on NW Estonian coast

- 15 km shoreline polluted
- thousands seabirds killed
- 10 tons of heavy fuel oil collected on shore

polluting ship not yet known

Recent marine oil pollution events, 5 March 2006

Cargo ship **RUNNER 4**, sailing behind icebreaker, got collision from the following ship and sank near Vaindloo, > 100 tons fuel oil onboard



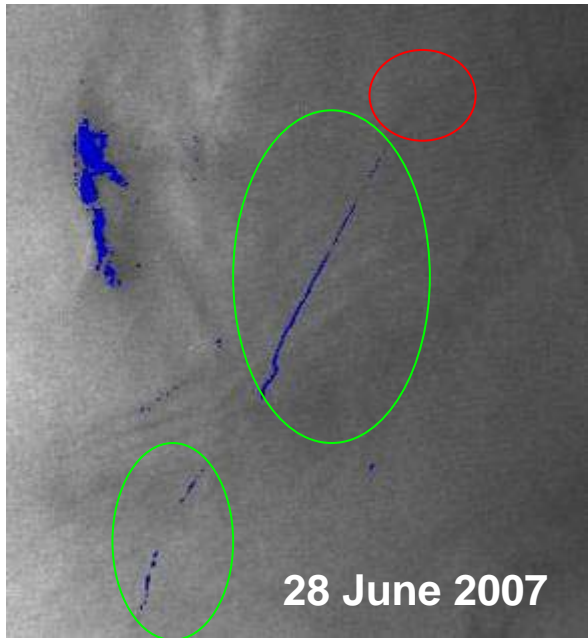
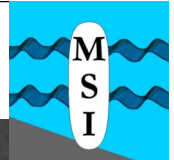
RUNNER 4
Length 80.22 m



SV. APOSTOL ANDREY
Length 128.28 m

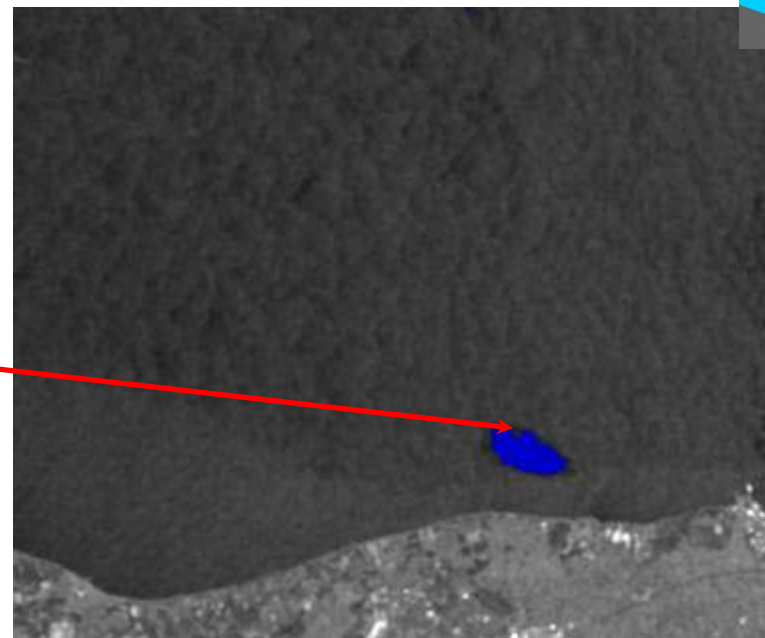


Oil spill detection using SAR images

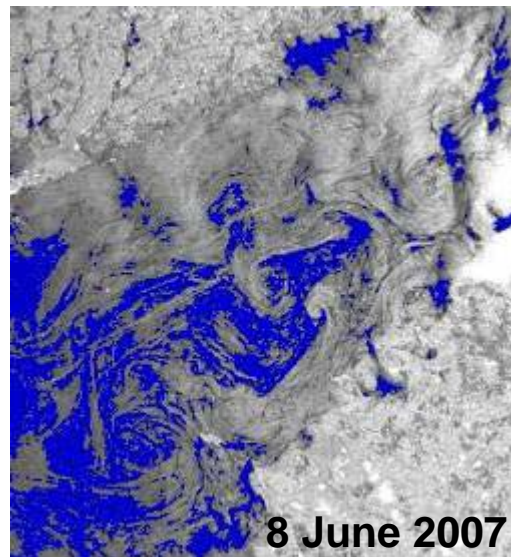


Pollution detected west from Saaremaa island (green) and probable polluter inside the red circle.

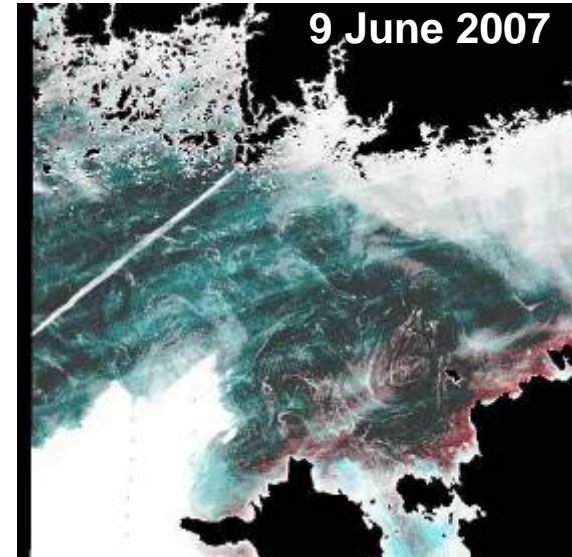
Detected pollution (blue) on SAR image near the Estonian coast (Narva bay) that was confirmed by air observation.



Raw SAR image on 8. June 2007



Structures detected as bloom.



Confirmation that the structure on SAR image is bloom, as the bloom was also observed on optical satellite image (MODIS).

Estonian aquatic scientists in Institute of Environment and Sustainability JRC

- **Peeter Nõges** (EMU Centre for Limnology) during 4 years as seconded national expert. At the moment Contractor Agent in JRC.
- **Toomas Tamm** (EMU Department of Water Management) in 2005 and 2006 as National Expert of Hydrology.
- **Madis-Jaak Lilover** (TUT Marine Systems Institute) during 4 years as seconded national expert.

Proposals for cooperation

EMU (Estonian University of Life Sciences)

Cooperation using JRC experimental laboratories and facilities. **Exchange of probationers and staff.** Analyses of stable isotopes to investigate matter circulation in water bodies.

Continuation of WFD implementation. **Intercalibration of methods** used in assessment of ecological quality. Addition of new biological elements to the intercalibration process.

TUT (Tallinn University of Technology)

Methods and tools for **high-resolution environmental assessments**, linking observations and models

UT (University of Tartu)

Developing **local remote sensing algorithms** for retrieving important water quality parameters in multicomponental coastal and inland waters (mainly the Baltic Sea and lakes). Studies on **underwater light climate** and inherent optical properties of coastal and inland waters.

Estimating the important spatial and temporal scales of environmental patterns and biota: improving **mapping methods and indices** of environmental quality.