SWERA
Marine Systems Institute
Tallinn University of Technology – TUT

partner introduction

Tarmo Kõuts
Senior scientist

SYKE, Helsinki, 15.05.2014
Founded in 1918
14200 students
1980 employees
8 faculties
3 research institutes
Yearly budget – 90 million EUR
Marine Systems Institute
at Tallinn University of Technology
Founded 2002, groups active since mid-1960-s

Staff: ca 50, PhD 19

Former structures

1965-1972: working group at TUT Sanitary Engineering Laboratory

1972-1990: Baltic Sea Department, TA Institute of Thermophysics and Electrophysics

1990-1992: Marine Physics Department, TA Institute of Ecology and Marine Research

1992-2002: Marine Physics Department, Estonian Marine Institute
Marine Systems Institute

Structure

Administration (Director: Jüri Elken)

Research Units
- Department of Marine Physics (Head: Urmas Lips)
- Department of Ecohydrodynamics (Head: Urmas Raudsepp)
- Laboratory of Marine Biochemistry (Head: Inga Lips)

Teaching Unit
- Chair of Oceanography and Meteorology (Head: Sirje Keevallik)
Marine Systems Institute

Research

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, FerryBox etc
• impact studies ← industry
• observation technology

Funding Structure:
Governmental, incl. grants 45 %
Research contracts 45 %
International 10 %
Marine Systems Institute

Education

Curricula in Earth Sciences
Faculty of Science
Marine Systems Institute jointly with Institute of Geology

Master Studies
PhD Studies

Specializations
Geology
Oceanography and Meteorology

Master Students (2 years) ca 30
PhD Students (4 years) ca 30
Infrastructure

The Earth Sciences research equipment was obtained within the R&D infrastructure project “Observatory of Coastal Zone Environment”. (about 2 million EUR)

After international evaluation, the project started in 2007 and finished in early 2010.

Partners: Marine Systems Institute (oceanography), Institute of Geology (geology, isotope methods) and Department of Environmental Engineering of the Faculty of Civil Engineering (river and drainage basin studies).

The project had three interlinked components:
• Laboratory for analysis of geological and water samples
• Complex of field research equipment
• Research vessel
OPERATIONAL MONITORING OF HARBOUR
DREDGINGS 2000-2013
OPERATIONAL MONITORING OF HARBOUR DREDGING

1. *In situ* measurements (CTD, turbidity, SPM concentration, CHLa, nutrients)
   
   ![Graph showing the relationship between remote sensing reflectance and suspended matter concentration. The equation is y = 0.0053x + 0.0033 and R² = 0.5827.]

2. Satellite remote sensing MODIS, resolution 250m

3. *Numerical modelling*
Flood in Pärnu, 9 January 2005
Sea level Information System

http://on-line.msi.ttu.ee/kaart.php

on-line data + 48h forecast

long-term data

summer

winter
On-line marine weather stations

http://on-line.msi.ttu.ee/uus_
http://on-line.msi.ttu.ee/aut_meteojaam/

Real time meteorological data from offshore stations to support navigation, experimental studies, modelling etc.
METOC data into AIS system

Data collector

Station 1 (RTR 1)
Sensor 1
Sensor 2
Sensor n

Station 2 (RTR 2)
Sensor 1
Sensor 2
Sensor n

Station n (RTR n)
Sensor 1
Sensor 2
Sensor n

GPRS Gateway

AIS Base Station

10 min

50 NM

AIS Router

NMEA Converter

Data expired? (> 15 min)

Data Collector

HM Data

GPRS / SMS

FTP Server

Timer driven process, once in 10 minutes

Receiver/Dispatcher

Format / FTP ch 1
Format / FTP ch 2
Format / FTP ch n

FTP Server

GPRS / SMS

FTP Server

FTP Server

5 min

5 min

5 min

Sensor 1
Sensor 2
Sensor n

Sensor 1
Sensor 2
Sensor n

Sensor 1
Sensor 2
Sensor n
EAS infrastructure investment project
“Observatory for Coastal Zone Environment”

Research Vessel SALME
32 m length, 202 GRT
35 years old, rebuilt in 2009

New instruments for:
- laboratories
- field work

Partners:
- TUT Institute of Geology
- TUT Marine Systems Institute
- Department of Environmental Engineering
Sampling
Example of oil spill detection from SAR imagery (2 March, 2008)

Pollution on ship lane

Ship1 coordinates – 58º17,94’N, 20º24,56’E.
Light on-line surface drifters

http://on-line.msi.ttu.ee/msibuoys
http://on-line.msi.ttu.ee/gmap

Gulf of Finland

Long-life, compact drifters with real time data transfer ability. Application area: ice drift and surface current measurements. Applications: navigation support, search and rescue, oil spills as well model validations, ice dynamics studies etc.
HIROMB model, core setups

HIROMB – a three-dimensional operational ocean circulation model

60 hour forecast 4 times a day

Modelled parameters

- Sea level
- Water temperature
- Currents
- Ice
- etc

1 NM setup

3 NM setup
HIROMB local setups

Local setups nested to core setup

More detailed forecasts

S. Baltic Proper 0.33NM (MIG)

HIROMB-EST 0.5NM (MSI)
Fuzzy logic model for *Nodularia spumigena* bloom:

1) Biomass 1 - expected biomass in the open sea
2) Biomass2 – suppresses unrealistic increase of modelled bloom biomass

Input into the model

- Surface layer temperature
- Wind mixing
- Excess phosphorus
- P transport by mixing
- P transport by upwelling
- Growth control
- Bloom transport (based on 3D model)

Physical conditions (mixed layer)

Phosphate conditions (mixed layer)

Biomass 1

Biomass 2

Harmful algal event in the coastal sea
Larger international projects

BalticSeaNow.info - Innovative participatory forum for the Baltic Sea

SNOOP - Shipping-induced NOx and SOx emissions - operational monitoring network

SAFEWIN - Safety of Winter Navigation in Dynamic Ice

EuroFLEETS - Towards an Alliance of European Research Fleets

ECOSUPPORT - Advanced tool for scenarios of the Baltic Sea ECOsystem to SUPPORT decision making

MyOcean - Development and pre-operational validation of upgraded GMES Marine Core Services and capabilities

ECOOP - European Coastal Sea Operational Observing and Forecasting System

SEADATANET - Pan-European Infrastructure for Ocean & Marine Data Management
Objectives

to survey Swedish, Finnish and Estonian wreck registers and identify wrecks having the most significant potential for oil pollution.
to study certain wrecks as case objects by underwater cameras and diving.

Partners in charge: **TUT, SYKE, CHALMERS, Alfons Håkans**
Task 1.1 Review of the Estonian, Finnish and Swedish wreck registers and selection of case wrecks for this study (TUT, SYKE, Chalmers)

Wreck registers will be studied and the present version of the VRAKA model will be used for the analysis to sort out wreck types. As wreck description in registries tends to be out of date in some cases, additional information will be collected from Maritime Museums and possibly other sources of information dealing with underwater archeology or possibly relevant organizations.
Task 1.2 Classification of selected wrecks, potential for oil spill (TUT, SYKE, CHALMERS)

Wrecks lay at different depths and accordingly hydrodynamic conditions around wrecks could be quite different. Also age and condition of wrecks vary in large extent. Classification of wrecks for further study will be performed taking into account above named circumstances.
Task 1.3  Field study of selected wrecks  (TUT)

Selected wrecks will be studied by underwater camera and diving. Condition of wrecks will be estimated as well hydrodynamic conditions around by *in situ* measurements . Possible wreck salvage operations organized by SYKE in 2014-2015 will be linked to this project execution (SYKE)
Task 1.4 Parameterization for ORRA (SYKE, Alfonshakans)

Parametrization of wreck types for oil removal operations is basic phase for WP3 objectives. In order design and execute successful salvage and oil removal operations a new approach is required to assess the realistic possibilities to conduct the oil removal with certain cost-benefit ratio. Each wreck and her environmental location has its own characteristics affecting on the oil removal technology. Defining the baseline factors and their interactions a novel analyses tool can be designed, also given the advice for the WP4 toolbox planning.
Deliverables (brief description and month of delivery)

M1.1 Systematization of wrecks performed (M2)
M1.2 Wrecks for case study identified (M3)
M1.3 Study of case wrecks performed (M6)
M1.4 Public seminar on wreck classification and survey involving stakeholders (M8)

D1.1 Report on wreck classification, potential for oil pollution (M6)
D1.2 Case study of typical wrecks in Estonian waters (M8)
D1.3 Parameterization of wreck types for ORRA (M9)