National Research Program "Climate Change Impact on the Water Environment of Latvia" (KALME)
2nd International Advisory Board Meeting
Daugavpils, May 8 2007

Welcome, adoption of agenda

KALME co-coordinator Andris Andrušaitis welcomed the participants (Annex I) to the second KALME advisory board meeting. He pointed out that among the nine Latvian state research programs, only KALME has organized an international advisory board to guide its progress and thanked the advisory board members for their commitment.

Andris Andrušaitis introduced the meeting agenda (Annex II), which similar to the previous year, will be organized as a series of work package presentations each followed by discussions. The meeting adopted the agenda and appointed Bärbel Müller-Karulis as rapporteur.

Artūrs Škute, the local host, conveyed the greetings of the vice rector of Daugavpils University.

Meeting participants

Project directors:

Prof. Andris Andrušaitis, co-director of KALME, holds a position as assistant professor at the Faculty of Biology of the University of Latvia, and a position at the Latvian Institute of Aquatic Ecology. He leads the project together with **Prof. Māris Kļaviņš**, professor at the Faculty of Geography and Earth Sciences of the University of Latvia. Project assistant, biologist **Ineta Plikša**, ensures the administrative functioning of the project.

Advisory board members:

Rolands Bebris is the Director of Environmental Protection Department at the Latvian Ministry of Environment. He serves as the Water Director in Latvia and represents the Latvian Ministry of Environment as the local end users of the project results. **Prof. Klaus-Peter Holz**, Brandenburg Technical University Cottbus (Germany), is a professor in civil and hydraulic engineering who specializes in hydroinformatics. **Prof. Enn Loigu** is the

director of Institute of Environmental Engineering at Tallinn University of Technology (Estonia). He has participated in research projects on changes in runoff regime and water quality under climate change. **Dr. Marcus Reckermann**, who was involved in assembling the BACC Assessment of climate change for the Baltic Sea Basin represents the BALTEX secretariat based at GKSS (Germany). **Prof. Ilppo Vuorinen**, University of Turku, Finland, is the director of the Archipelago Research Institute. His research focuses on zooplankton and he has contributed with his analysis of zooplankton time series to the BACC (Assessment of climate change for the Baltic Sea Basin) project.

Work packages leaders:

Dr. Uldis Bethers (WP 1) is the deputy head of the Laboratory of Mathematical Modeling of Environmental and Technological processes at the University of Latvia. His primary research interest is modeling of physical processes in the environment. **Prof. Viesturs Jansons (WP 2)** is a professor at the Latvian University of Agriculture with expertise in monitoring and modeling of non-point source pollution. **Dr. Gunta Spriņģe (WP 3)** is the leader of the Laboratory of Hydrobiology at the Institute of Biology at the University of Latvia and assistant professor at the Faculty of Geography and Earth Sciences of the University of Latvia. She studies the impact of climate change on biodiversity, structure and functioning of freshwater biological communities. **Prof. Guntis Eberhards (WP 4)** is an expert on coastal processes, especially coastal erosion. He holds a position at the Faculty of Geography and Earth Sciences of the University of Latvia. **WP 5** is led by **Dr. Juris Aigars**, the director of the Latvian Institute of Aquatic Ecology. Dr. Juris Aigars is a geochemist interested in the dynamics of nutrients at the sediment water interface. **Dr. Anda Ikauniece (WP 6)** is a researcher at the Latvian Institute of Aquatic Ecology. She is a biologist working on the dynamics of marine zooplankton populations. **Dr. Kristīne Āboliņa (WP 7)** is a docent at the Faculty of Geography and Earth Sciences of the University of Latvia and is primarily interested in analyzing communication between scientists, the public, and decision makers. **Prof. Artūrs Škute (WP 9)** from the University of Daugavpils is a biologist involved in freshwater ecological research focusing on invertebrates (zooplankton, zoobenthos).

KALME structure and work packages

Program overview (M. Kļaviņš)

Co-director Prof. Māris Kļaviņš gave an overview of the KALME research program, which is the smallest of the nine Latvian state research programs and for the first time introduced aquatic research among the dedicated research funding programs. KALME employs an integrative approach by addressing both the environmental as well as the societal aspects of climate change, including the entire water cycle from the drainage

basin and inland waters to the coastal zone and the marine environment. KALME also furthered the cooperation between Latvian researchers and helped to established their research within the European research community.

Māris Kļaviņš gave a brief overview of the cooperation and information flow between the KALME work packages (Fig. 1) and further presented the main project achievements, which are also reflected in the KALME second phase report, handed out to all meeting participants. Further information can also be found on the project web page, www.daba.kalme.lv.

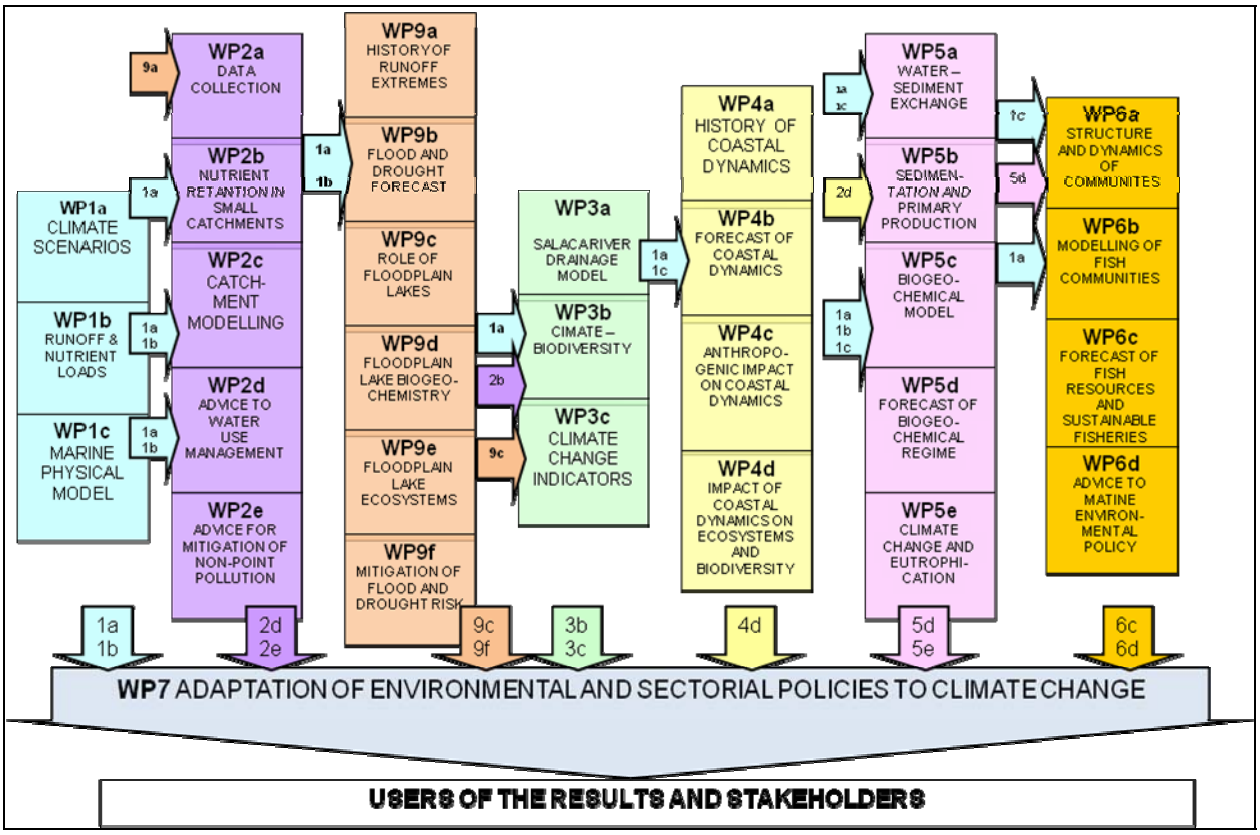

Figure 1: KALME work packages and their interaction

Delivery of research results

The results of the KALME project were presented at several national and international conferences in Latvia, raising the public awareness about the consequences of climate change. Together with the INTERREG ASTRA program, an international conference "Climate change and waters" was organized in Riga May 10 – 12, 2007 with more than 125 participants from 18 Baltic Sea region countries. In February 2008 KALME organized a national meeting in the framework of the annual conference of the University of

Latvia, where KALME participants reported in Latvian with 20 presentations on their project results. Further, with additional financial support from INTERREG ASTRA, a book on the nature and consequences of climate change in Latvia, and potential adaptation strategies of climate change in Latvia was published (Climate Change in Latvia, Latvijas Universitātes Akadēmiskais apgāds, 268 pp).

Performance indicators

Performance indicators of the KALME project (Table 1) show that the program has established its work successfully. In particular, KALME fulfills one of its main goals, to support PhD students and young researchers. Compared to other "traditional" post-Soviet institute research programs, the number of young researchers involved is high.

Peformance indicators and auditable values	Number
Monographs	1
Defended PhD thesis	3
Young researcher, PhD and MSc students involved in the program	40
Scientific publications in international and local sources	38 articles 35 abstracts
Reports to media	19
Presentations and conferences	48
New methods reated	6
Conferences and seminars organized	3
Recommendations for elaboration of environmental legislation, participation in the decision-making process and implementation of these decisions	12
Original maps	7
Laboratory devices acquired and built	13

Table 1: KALME project performance indicators

Problems occurring in the work of the research program

Māris Kļaviņš pointed out that some of the results of research program are slightly delayed, mainly due to delays in the start of the funding and delays in the payment for research infrastructure to be procured for KALME. He also pointed out that currently Latvian politicians have showed little interest in the program results and are not yet aware that climate change and adaptation strategies have to be taken seriously.

He also pointed out, that even though KALME has produced a high number of scientific publications; many are submitted to "grey" literature and local sources. As an intermediate goal of the program, by the end of 2008 half of the KALME related publications should be published in SCI journals.

Goals of the advisory board meeting

Māris Kļaviņš formulated the main expectations and goals for the current advisory board meeting:

- provide advice on finalizing and publishing the KALME research results
- suggest improvements to the project management structure

Work package presentations and discussion

WP 1: Climate change impact on runoff, nutrient flows and regime of the Baltic Sea (Uldis Bethers)

WP 1 coordinator Uldis Bethers presented the status of the work package. Goal of WP 1 is to model several scenarios of the potential changes in the water environment, using existing climate change scenarios for the Baltic Sea region. The work package comprises of several tasks with associated deadlines, which are partially completed or still on progress (Table 2).

Task **Description, expected completion**	**Achievements**	**Tasks planned for 2008**
WP1a. Scenarios Evaluate and adapt the results from the regional climate models, and design the series of data which form the state of the water objects Expected completion: October 2007	Completed in 2007 • Investigated access to RCM numerical results • Method for RCM comparison developed (scientific novelty) • Selected best RCM • RCM data quality control via runoff modelling performed (new approach in Latvia) • Systematic non-compliance of observed and modelled climate found for reference period • Method for RCM correction developed (scientific novelty) • Scenarious prepared (T, p for Latvia) (1st time done for Latvia – practical novelty) Features of future T & p expectations analysed	None, completed
WP1b. River modeling Investigate and forecast the impact of the climate	During 2007: • Geospatial information organised • Model (FiBasin)	• Solving detected quality issue • Runoff scenarious • Nutrient load

change on the river runoff and its seasonal variability Expected completion: July 2008	developed/tested in pilot basin – Aiviekste During 2008: • MIKE SHE tested (Bērze) • MIKE BASIN tested (Bērze) • Extension of FiBasin calibration tested (Aiviekste vs. Abava), good agreement found. • 2nd order non-compliance of observed and modelled climate found via runoff modelling. The correlation between p and T are higher in RCM during winter months – snow amount underestimated.	scenarious
WP1c. Sea state modeling Adapt 3D sea state models to produce the data series for the forecast of biogeochemical processes and sea ecosystem evolution Expected completion: January 2009	During 2007: • Modelling area selected • Model (SwEvolver 3D, used in operational modelling) adapted and tested During 2008: • Reengineering of numerical engine of SwEvolver 3D to ensure 30+ year stable run	• Access to climatic "virtual ocean" for Baltic sea via BOOS cooperation • Sea state scenarious
WP1d. Support Provide modelling and data analysis support for other WPs. Task foreseen in 2009.	Modelling helpdesk established since January 2008.	Ongoing task in 2008 and 2009

Table 1: Work package 1 status and tasks for 2008

Advisory board questions and suggestions:

- Address groundwater – surface water interactions and riverine nutrient loads

Enn Loigu addressed the interactions between groundwater and surface water, which should be included into river runoff modeling, and pointed out that the share of groundwater fed baseflow currently increases in Estonian rivers. Uldis Bethers assured

that groundwater – surface water interactions are currently included into the river model, but require a long start-up period for the model to generate a stable groundwater state. Referring to modeling riverine nutrient loads, Uldis Bethers pointed out that they are included into WP 1, but this task is still ongoing and its results are not ready yet to be presented.

- Data quality and climate scenario precision

Viesturs Jansons was concerned about the quality and sources of f hydrometeorological observations used for regional climate model (RCM) correction. In response, Uldis Bethers pointed out that all datasets used were tested for compliance with observations with 14 meteorological stations in Latvia, Lithuania, Estonia and NW-Russia, whose data is publicly available from internet sources (Meteorological Service of Russia and World Meteorological Organization). Even though some discrepancies in the datasets were found, he pointed out, that both the representation of the current climate as well as the climate change scenarios are generated by climate model and both represent "virtual reality". With respect to correcting RCM data, he suggested that in the future corrections will become less important, as the quality of RCMs will improve. Ilppo Vuorinen added, that the model reference period (1960 – 1990) already includes climate change processes which are not fully understood yet and therefore also not explained by the climate models. Therefore, the reference period might show a shifting climatic baseline and the actual differences between model scenarios and the baseline might be underestimated.

Prof. Holz cautioned that Latvia is located on the edge of most European climate models and therefore model results might not be accurate. Uldis Bethers added that this issue was discussed with colleagues at the Danish Meteorological Institute, who confirmed that European RCMs are known to produce anomalies in Northwest Russia. Further, Prof. Holz suggested restricting the discussion of climate model deficits to problems that significantly impact other work packages. Most important, as Uldis Bethers added, is that all work packages should be aware that RCM output cannot be used without corrections as input into hydrological and biogeochemical models. For RCMs it is often sufficient to demonstrate how the modeled future climate deviates from the modeled baseline, but KALME work packages require absolute values of future climate parameters, e.g. temperature and precipitation.

- Focus on modeling transient climate change or on future "steady state"?

Uldis Bethers raised the question, whether WP 1 should focus on depicting conditions in the future climate described by the RCMs, or whether WP 1 should also try to describe conditions during the transition from present to future climate. He welcomed experiences from similar projects with the use of transient and steady state approaches.

- Include natural variability and abrupt changes

Both Ilppo Vuorinen and Marcus Reckermann pointed out that natural variability in both present and future climate is high. Climate change might also by cyclic and/or abrupt, to which biological systems can respond by regime shifts. Therefore WP 1 scenarios should capture natural climate variability. Uldis Bethers assured that RCMs produce some signals of natural variability, because variability is included into the model forcing.

WP 2: Climate change impact on the nutrient runoff in drainage basin (Viesturs Jansons)

Goal of work package 2 is to generate water quality scenarios for Latvian surface waters. This will be achieved by a hydrological and water quality modeling in the Bērze catchment, combined with intensive monitoring of nitrogen leakage from agricultural plots, drainage systems and from small catchments.

In his presentation, WP 2 coordinator Viesturs Jansons first described the current situation with regard to the measurement methods and technological options for monitoring diffuse pollution, and then, presented a review of the main results of the work package.

During 2007, GIS information on the characteristics of the Bērze catchment was collected and modeling data sets including water quality samples for the Bērze River and its sub-catchments were assembled. Water samples were analyzed by the Latvian Institute of Aquatic Ecology. Additional data collection will be organized in 2008.

Assessment of the nutrient concentrations and loads on the monitoring scale soil - field drainage - small catchment showed substantial nutrient retention. Mean NO_3^{-1} and N_{tot} concentrations measured in the Bērze and Mellupīte monitoring sites decreased by an average of 30 - 35% (3 – 4 mg/l), while little change in the nutrient concentrations occurred in the Vienziemīte site. Low nitrogen retention in the Vienziemīte field drainage and catchment is caused by the low input agriculture and concentrations close to the natural background levels.

Calibration of the hydrological model METQ2007BDOPT was performed for long term periods in selected river basins in Latvia (15 sub-catchments of the Bērze, Salaca, Imula, Iecava and Vienziemīte rivers). The model calibration demonstrated acceptable applicability of the model, as simulated and observed discharges for most of the selected river basins agreed well. Therefore the model can be used for further simulation of hydrological processes.

The FYRIS model developed by the Swedish University of Agricultural Sciences (SLU) was validated for water quality assessment in the Bērze River and in 15 homogeneous sub-catchments of the river. First modeling results were obtained for the source apportionment of the riverine nitrogen load in the Bērze river basin. Experience from

other modeling approaches suggest that longer data series than gathered would be required to improve model results.

Besides, the impact of the extreme weather conditions during the dry summer in 2006 on nitrogen loss in the field level was demonstrated.

Advisory board questions and suggestions:

- Include effects of land use change

Enn Loigu pointed out that WP 2 results analyze the current nutrient loss processes in very much detail. However, climate change will also induce farmers to switch to more temperature sensitive crops – for example, already presently farmers replace winter rye by barley -, increasing the time-period of unvegetated soils and leading to higher nutrient leakage. Viesturs Jansons replied that currently no agricultural land use scenarios are available for Latvia. Additional, he added that the uncertainty in addressing future nutrient losses is high. For example, climate change will prolong the vegetation period, generating higher yields and therefore also reducing the nutrient loss. Additionally the fraction of "green land" can be increased during winter. Currently the ground is generally frozen in winter and 64 % of runoff and nutrient leakage are generated in spring. Crucial might also be the impact of dry periods in summer, which will generate a high nutrient pool in the soil that plants cannot utilize. Prof. Holz added that land-use scenarios always involve high uncertainty because of market fluctuation, but advocated to generate plausible scenarios which should be included into model scenarios. Further, he suggested WP 2 to contact existing research groups on agriculture and climate change, which have already researched adaptation and crop change strategies. Also Andris Andrušaitis agreed that WP 2 should include the effects of land-use change on nutrient loads.

- Develop recommendations for political decision makers based on current climate conditions

Māris Kļaviņš suggested including recommendations for political decision makers into the project, also under current climate conditions, to assist for example the implementation of the EU Nitrate Directive. Viesturs Jansons complained that currently scientific data are insufficient to develop recommendations, but ad-hoc measures as the increase in green land and construction of artificial wetlands are proven methods to decrease nutrient leakage.

- Include nutrient retention in the Daugava River on the list of potential future research tasks

Marcus Reckermann asked whether studies on nutrient retention in the Daugava River are available. As only Silica retention has been previously studied, he suggested including the topic on the list of potential future research tasks.

- Focus model development on forecasting nutrient loads

Andris Andrušaitis inquired on the ability of WP 2 to forecast future nutrient loads and pointed out, that within KALME WP 2 is responsible to generate nutrient load scenarios, which represent the "best guess" of the researchers involved. Viesturs Jansons reported that forecasting will be started when high-quality climate scenario data will be available from WP 1. Forecasting will be based on the FYRIS model. He pointed out that it is difficult to use the RCM data to generate model output on a daily scale.

Marcus Reckermann also suggested that WP 2 should focus on the connection to WP 5, i.e. on generating nutrient loads to the Gulf of Riga. Prof. Holz added that manpower in WP 2 is not sufficient to add detailed studies of plot and field levels. However, Viesturs Jansons opposed that only little information on nutrient retention is available for Latvian conditions. Also Enn Loigu admitted that the use of nutrient retention models can be locally very difficult, as very often e.g. land use statistics are not known and export coefficients are not available.

To ensure the functioning of the KALME project, Andris Andrušaitis proposed to organize a WP 2 – WP 5 seminar to discuss scenarios and inputs necessary to forecast the state of the Gulf of Riga. Māris Kļaviņš pointed out, that nutrient load scenarios generated by WP 2 are essential for reaching the KALME deliverables and aims.

WP 3: Climate change impact on freshwater ecosystems and biological diversity (Gunta Spriņģe)

The main tasks for WP3 are devoted to three main research directions: climate-biodiversity, climate change indicators, and fluxes-climate-biota.

In 2007 long-term data on climate parameters (air temperature, annual precipitation, and discharge), the chemical composition of the water, and biological data were summarized and long-term changes were analyzed for the River Salaca and Lake Engure. Increasing trends were found for air temperature, river discharge mainly in the winter period, water colour and COD since 1991. Only in several water monitoring stations the concentrations of NO_3-N and PO_4-P followed increasing trends, and all these positive trends occurred from 1980 to 1990. Accordingly, all statistically significant negative trends were found from 1991 to 2001. Phytoplankton biomass (mg l^{-1}) in the

River Salaca during the 1990ies decreased in comparison to the 1980ies and then some increase was observed since 2001. An increase since 1986 was also observed in macrophyte cover that in some reaches has come up to 80 – 90 %. At the same time benthic invertebrate cenoses were stable.

A database was developed covering the migration of smolt from salmon and salmon trout since 1964, including their biological characteristics. A similar database for lampreys covers the time period since 1960. Also data on coastal and sea fishing from 1984 to 2007 were summarized. Data on electrofishing since 1992 was added as well as a databases on fishing of 735 lakes covering 1949 to 2006. Distribution of potential indicator species – vendace *Coregonus albula*, whitefish *Coregonus lavaretus*, lake smelt *Osmerus eperlanus*, bitterling *Rhodeus sericeus* and sander *Stizostedion lucioperca* – in the lakes of Latvia were summarized. Further, it has been shown that most of fish diseases in aquacultures in Latvia are closely connected with seasonal water temperature.

Studies of organic carbon flow in the Salaca showed that concentrations of total organic carbon (TOC) are connected with seasonal changes in water discharge. In 2007 also investigations of algae and benthic invertebrates drift were carried out in all main river basins.

Advisory board questions and suggestions:

- How can climate and eutrophication signals be separated?

Enn Loigu suggested that the work package should be careful to separate the effects of eutrophication and climate change on biological parameters, e. g. on macrophyte overgrowth. Gunta Spriņģe agreed that eutrophication and climate impacts on overgrowth are difficult to separate. However, the eutrophication impact on the Salaca River is currently low, and even though fertilizer use has increased again, the nutrient load is still comparatively low. Currently, data do not show changes in nutrient concentrations, and therefore increased nutrient loads are probably not responsible for the observed ecosystem changes. However, modeled nutrient loads will be included in predictive scenarios of the biological state of Latvian freshwater ecosystems.

- Analyze the indirect effects of temperature increase on freshwater ecosystems

Enn Loigu wondered why the work package puts only little emphasis on temperature changes in rivers and lakes and their ecosystem effects, for example on oxygen concentrations. Oxygen concentration at saturation decreases in warmer water, therefore temperature increase could be expected to reduce oxygen content. Māris Kļaviņš opposed, that most lakes in Latvia are eutrophic with oxygen oversaturated water columns during summer. However, in oligotrophic water bodies the effect of temperature on oxygen content could be different. Currently, a decrease in oxygen

concentrations is mainly observed in shaded rivers with low velocity, which does not apply to the Salaca River and Lake Engure. Ilppo Vuorinen added that studying the effects of temperature increase requires analyzing the relationship between air and water temperature and their temporal trends during 20th century, together with long-term scenarios for water temperature. So far, Gunta Spriņģe perceived the earlier start of the vegetation period due the shift in the increase in water temperature from the end of April to the beginning of May as the major effect of temperature change on freshwater ecosystems.

- Present the changes in phytoplankton concentrations in the Salaca river in more detail

Marcus Reckermann proposed to analyze the sharp increase in phytoplankton biomass observed after 2000 in the Salaca River (Fig. 3.2 of the KALME phase II report) in greater detail. Ilppo Vuorinen pointed out that the increase was restricted to the upper reach of the river. Gunta Spriņģe added that the upper reach is formed as the outflow of a eutrophic lake, whereas the lower part is fast flowing and more sensitive to climate change.

- Is the focus on biological indicators of climate change justified?

Andris Andrušaitis pointed out that it might be more important to generate freshwater quality indicators that are robust under climate change conditions, for example for use in Water Framework Directive related assessments, than to generate biological indicators of climate change. Gunta Spriņģe stressed the importance of biological indicators of climate change, but agreed that climate dependency of indicators used for other purposes must be researched and included into assessments. Also Ilppo Vuorinen pointed out that biological indicators play a special role among water quality indicators, as they document system changes that are very visible to the general public. Marcus Reckermann suggested that indicators should focus on water quality in general and that it should be known how much the water quality indicators are affected by climate change.

WP 4: Coastal Processes (Guntis Eberhards)

The objective of WP 4 is to analyze coastal changes and forecast the impact of climate fluctuations on coastal dynamics and coastal ecosystems in Latvian territorial waters in order to describe the quality and biological diversity of the marine environment, marine resources and services for their sustainable use.

Tasks during KALME phase II:

1. Systematization of published and archived materials (e.g. maps and plans) from the 20th century and preparation of digital maps of coastal processes, as well as

systematization of historical cartographic and bathymetry plans and maps to estimate coastal changes (retreat, accretion) in Latvian harbors.

2. Estimation and characterization of coastal geological processes in the 20th century to present. Determination of changes in coastal erosion and accumulation zones in connection with hydrotechnical activities (harbors etc.), and estimation of their influence on coastal dynamics.

3. Creation of maps of coastal erosion and accumulative processes during the 20th century to present. Field works: Mapping of the coastal erosion zones after winter-spring storms (2006/2007). Mapping of protective structures and erosion risk at selected sites in the Gulf of Riga.

Results:

Several digital maps were produced based on the review of historical data: Latvian coastline dynamics during the past 2500 years, coastal processes in the Gulf of Riga in the 1950ies, coastal erosion during the 1969 hurricane, coastal processes in Latvia at the beginning of the 1980ies. In 2008 the maps will be published as an atlas "Coastline change and modern coastal processes in Latvia" (25 maps).

The earliest topographical measuring plans of the land surface (1935 – 1938) at scale 1:5 000 and 1:2 500 as well as Soviet topographic maps produced in the 1980ies (scale 1:10 000)have been analyzed. The review of maps and plans allowed to determine coastal changes during the last 50 – 60 years (1935 – 1990), to determine the long-term mean and maximum rates of coastal erosion, as well as to produce digital maps (coastal changes and processes in the 20th century).

Assessment of coastal processes during the past 15 years was based on long-term monitoring data of coastal geological processes and mapping of coastal erosion cells after storms. Results are presented in several maps: Coastal change and modern processes (1992 – 2007), coastal geology, high risk coastal segments, coastal erosion during the storms in 2001, 2005, and 2007, Latvian harbour activities and sediment loss, coastal erosion determined by local factors.

Quantitative information on the distribution of coastal retreat and associated erosion rates were obtained for the first time in Latvia.

Further, the results obtained in KALME phase II will serves as a basis for phase III (2008), focusing on coastal erosion forecast, flood risk of low-lying coastal areas, and risk assessment for the future 30 – 50 years under climate change impact.

Tasks for KALME phase III (2008):

- Continuation of coastal change mapping and measuring of coastal erosion after winter storms in 2007/2008
- Finalization of mapping and estimation of the efficiency of coastal protective structures (Baltic Proper coast), preparation of digital maps
- Preparation of coastal erosion forecasts for different climate change scenarios.
- Preparation of digital maps for coastal administrative units to be used for planning and management purposes

Advisory board questions and suggestions:

- Consider the effects of sea level rise and post-glacial uplift on coastal processes

Ilppo Vuorinen suggested giving more emphasis to the effects of sea level rise on coastal erosion. He pointed out that expectations on sea level rise are only mentioned briefly in the KALME phase I report and suggested to consider scenarios how e.g. 1 m sea level rise would affect coastal erosion, as well as on strategies to protect coastal cities in the case of sea level rise. Based on the experience from the BACC project Marcus Reckermann pointed out that sea level rise receives a lot of attention from the media. He also added that the role of post-glacial uplift should be analyzed in connection with potential sea level rise.

Guntis Eberhards pointed out that during the third phase of the project simple predictive approaches based on empirical formulas will be applied to forecast the effect of sea level rise on coastal erosion. However, this approach cannot account for changes in the long-shore sediment drift, which is important for coastal dynamics on the Latvian Baltic Proper coast. Forecasting is currently planned to focus on the coming 15 – 30 years rather than on long-term changes during the coming 100 years, for which sea level rise will be more relevant. Current post-glacial uplift data for Latvia are not available, according to the most recent information Riga is settling, partially due to groundwater withdrawal, whereas the northern part of the coast (Kolka) lifts about 1 mm/year.

- Include information on currents and waves into the coastal process atlas; make maps available in digital format on the internet in a sustainable way

Enn Loigu further addressed the potential impact of long-term changes in coastal currents on coastal processes and suggested to include long-term observations of wind and currents into the analysis. Also Prof. Holz pointed out that maps of dominant currents and wave directions would further increase the value of the coastal process atlas and suggested that all maps in the report should be available in digital format on the internet for coastal planning purposes. Maps and materials should be available in a sustainable way also after the end of the project.

- Identify coastal sections where erosion can be tolerated

Prof. Holz emphasized that the coastline is too long to allow detailed danger assessment by coastal erosion modeling and to permit protection of the entire coastline from erosion. Instead, he suggested to identifying coastal sections where erosion can be tolerated.

- Organize workshops on coastal protection

Roland Bebris reported that municipalities are interested in practical workshops on coastal protection, including proposals on how to ensure environmentally sound protection of the shore. As to measures for shore protection, both Guntis Eberhards and Uldis Bethers pointed out that in most cases a combination of beach feeding and coastal protection gives good results.

- Address restriction of sediment dumping to deep waters

Guntis Eberhards pointed out that currently Latvian legislation demands dumping of dredged material in deep waters and prohibits near shore deposition. Annually, 2 Mio m^3 of dredged materials in Latvia are dumped in deep waters, increasing the coastal sediment deficit and furthering coastal erosion. Juris Aigars proposed that the project should publicly address the issue of systematically removing sediments to deep water through WP 7.

WP 5: Biogeochemical processes and primary production in the Baltic Sea (Juris Aigars)

WP 5 aims to predict the impact of climate change on the biogeochemical cycles and the ecosystem of the Baltic Sea. During KALME phase II, WP 5 tasks were generally fulfilled according to the agreed time table. However, the completion of the experimental system was slightly delayed because of funding shortages at the beginning of 2007, when the project funding was not provided according to the agreed time table. As a result only one of the two experiment runs planned was completed by the reporting deadline. The aim of experiment is to establish critical values of environmental conditions under which changes in biogeochemical processes in surface sediments and their overlaying water can be observed.

During the experiment eight sediment cores with overlying water were initially maintained under ambient temperature and saturated oxygen concentrations. Gentle stirring of the overlying was provided by a rotating mixer. At the 4^{th} day of the experiment the oxygen concentration in half of the experimental columns was lowered to approximately 1 ml l^{-1}. The observed sediment response showed large dispersion among experimental columns, most likely due to presence of macrozoobenthic organisms. Therefore it is necessary to repeat the experiment under the same conditions to give larger certainty to the observed results.

Planned tasks for the WP 5field component, e.g. establishment of a sediment multitrap, were performed with delay from the work time plan due to the shift in project funding time mentioned above. This resulted in later procurement than planned. The purchased sediment multitrap was received only in autumn, when due to logistical reasons it was not possible to commence the planned equipment field testing. Furthermore, prior to sediment multitrap deployment, a navigation buoy to mark the site as a protected area must be established. This will be possible to complete only in summer 2008.

For calibration of the biogeochemical model, data on nutrient loading to the Gulf of Riga were collected, as well as nutrient, phytoplankton and zooplankton concentrations in the Gulf. Special attention was given to the preparation of phytoplankton input data, as changes in the analyses methodology and sampling frequency since 1995 systematically influenced the phytoplankton time series and resulted in underestimated biomass for blue-green algae and species with small cell size.

During 2007, the original model code of the biogeochemical model was reengineered and simplified to adapt the model to long-term predictions. The model code was transferred from Visual Basic 6, which will be no longer supported by Microsoft, to Visual Basic .net 2008. The parameter calibration algorithm was replaced by a simulated annealing type that allows a greater degree of randomness in the parameter search. At the same time, the model structure was simplified. The coastal box of the model, which was not able to realistically depict coastal – open sea gradients, was removed and the silica cycle was omitted. Presently, silica does not limit phytoplankton development in the Gulf of Riga and climate change is not expected to systematically decrease the Si:N or Si:P ratios in the nutrient input to the Gulf. Therefore we do not expect silica to become a limiting nutrient due to climate change. While reengineering the model code, process parameterizations were simplified, e.g. by removing explicit temperature dependencies in primarily nutrient or food limited growth rates.

Currently, the reformulated model is recalibrated with data from 1973 – 2003 for the Gulf of Riga. Initial simulations show typical seasonal dynamics of nutrients and phytoplankton. Quality checks also confirmed that the model is mass balanced for N and P.

Advisory board questions and suggestions:

- Should historic sediment data, especially information on historic Soviet pollution be taken into account?

Enn Loigu asked whether historical sediment data are available for the Gulf of Riga and whether pollution during the Soviet period can be expected to influence sediment biogeochemistry. However, as Juris Aigars explained, the role of nutrient inputs and pollution during the Soviet period is unclear, because sediment focusing and internal

transport in the Gulf of Riga are high, as only 28 % of the Gulf is located in sediment accumulation areas.

- Include mechanisms for phosphorus binding in the sediments into the experimental work

In response to Enn Loigu's question, by which mechanism phosphorus is fixed in the bottom sediments, it became clear that the primary mechanism in the Gulf of Riga is unclear. Juris Aigars pointed out that typically iron is responsible for binding phosphorus in bottom sediments, but in the Gulf of Riga, where sediment phosphorus and iron content correlate only weakly, calcium or biological binding might be important.

- Be careful to capture temperature effects in the biogeochemical model

Marcus Reckermann pointed out that temperature dependent rates are important in a biogeochemical model that is expected to capture climate change effects. Also Andris Andrušaitis emphasized that even if it is assumed that indirect temperature effects dominate, it has to be assured that those are depicted by the model, e.g. the effect of changes in stratification on timing and duration of phytoplankton blooms.

-Is the attention to cyanobacteria blooms justified?

Ilppo Vuorinen questioned whether climate change in the Gulf of Riga would increase cyanobacteria blooms. He pointed out that cyanobacteria are typical of the open Baltic Sea, but if climate change increased freshwater runoff and consequently reduced salinity of the Gulf of Riga, conditions might even become less favorable to cyanobacteria than presently. Additionally, cyanobacteria depend on calm weather conditions and it is currently not clear how climate change will influence water column stability and stratification. It is also possible, as Marcus Reckermann added, that under future climatic conditions oxygen depletion and consequently phosphorus release from bottom sediments might increase, enhancing cyanobacteria blooms. As Enn Loigu mentioned, changes in nutrient limitation have e.g. occurred in Lake Peipsi, where very pronounced cyanobacteria blooms occur today, which were absent under the high nitrogen loading during Soviet times.

- Ensure cooperation with WP 1 for climatic input scenarios

Andris Andrušaitis pointed out, that WP 5 and WP 1 should together define necessary and possible climate scenario input data for predicting the future biogeochemical state of the Gulf.

WP 6: Climate change impact on ecosystems and biological diversity of the Baltic Sea (Anda Ikauniece)

WP6 had three general directions of work in 2007 – experimental studies on phytoplankton community response, data collection during the field work at the Latvian Baltic Sea and creation of a fish community model for the long-term projection of fish stock and production. Due to the deviations in the funding schedule, the experimental work was started almost half a year later than initially planned and only one series of investigations was completed instead of three. The studies of autumn phytoplankton community response revealed that if the water cooling and mixing is delayed, the autumn bloom can reach high values of phytoplankton biomass. Three other experimental studies are in different stages of completion. The field work included sampling of nine coastal stations from Ovīši to Nida and three stations in the Eastern Gotland Basin. The coastal stations were sampled monthly in April – November and the Gotland Basin stations in May, August and November. Data on physico-chemical parameters and biological variables were collected. Preliminary results revealed the expansion of the anoxic zone in the deeper parts of the Gotland Deep and the response of the benthic community by change of species structure.

For preparing a fish community model, fish time-series data were digitized. Six time-series of various fish species and populations together with important environmental factors form the basis for the long-term community model. Some relations are quite well-seen and proven, e.g. between the Gulf of Riga herring recruitment, spring water temperature and abundance of zooplankton. Other links have to be elaborated and tested though. The plans for the year 2008 include completion of experimental work and analysis of field samples, subsequent analysis of the results, presentation and publication of the outcomes and co-operation with WPs 1, 4, 5, 7.

Advisory board questions and suggestions:

none

WP 7: Adaption of environmental and sectorial policy to climate change (Kristīne Āboliņa)

During KALME phase II, WP 7 covered the following issues:

1. Identify possible impacts of climate change on the water environment in Latvia (in relation to environmental and development policy) in the context of resource management.

Possible impacts of climate change were identified, potentially impacted sectors by climate change determined. On this basis a list of partners for further cooperation was compiled, including decision makers, planners, local governments and sector specialists.

2. Analyse normative acts and planning documents in the context of climate change policies

Conclusions: the need to include climate change factors in Strategical Environmental Impact Assessment procedures, the need of the vulnerability assessment, the need to include the environmental risk in risk management principles.

3. Undertake a survey of municipal and other government institutions

A survey was done in August – November 2007 with 94 respondents.

Outcomes of the practitioners survey:

- There is awareness about climate change and its possible impacts
- There is awareness about the need for adaptation
- There is a need of knowledge about adaptation instruments

This is in contradiction with real politics, conclusion: possibly very low priority of climate change and sustainability issues.

4. Foster dialogue between climate change and water resource researchers and development planners, policy-makers in national institutions, municipal institutions and the business sector

Discussions with the Ministry of Environment, Discussion Club on Climate Change - The Strategic Analysis Commission under the Auspices of the President of Latvia in cooperation, participation in meetings of the National development committee of Latvia on the National Development Plan and the National Sustainable Development Strategy, British Council in Latvia project about Climate Change, participation at meetings of the Latvian Association of Local and Regional Governments and others.

WP7 tasks for the KALME phase III (2008):

1. Based on the results of the survey of municipal and state specialists an action plan for an on-going dialogue between KALME researchers and practitioners will be developed.
2. Continuation of dialogue between climate change and water resource researchers and state and municipal level development planning specialists and the business sector.
3. Preparation of a publication on the results of the survey of state and municipal institution specialists.
4. Ensure that the results of the research program are integrated into the Latvian climate change adaptation strategy through participation in the work group.

Challenges for this task:

1. Line of responsibility of scientists and practitioners
    - Exercise to use modelling results (WP1) in WP2-WP6
    - The courage to define advices for policy (e.g. land use in agriculture)
    - We need more than scientific publications (+Diena)

2. Priority list of adaptation measures
3. Possibility to compare climatic and anthropogenic influence and to give recommendations (added value of project)

Constraints for work: Underestimated amount of work to be done and the first results of some WP are not yet appearing (no results – no reason for discussion with stakeholders).

Possibilities for 2008: Excellent, experienced and creative colleagues in our research program!

Advisory board questions and suggestions:

- Broaden the scientist – public interface -involve media experts and apply new technologies for communication

Prof. Holz advised the project to take into account the orientation of politicians towards gathering votes in designing its communication approach. He suggested to rely also on mass media for communication with a broader public audience and to involve media experts in designing a communication strategy. Andris Andrušaitis added that a national project alone can do little to change public awareness, as global awareness to environmental issues is mainly formed by global media, and pointed out that KLAME is the only Latvian research program with a stakeholder involvement work package. Marcus Reckermann also agreed that the interface between politics and science must be strengthened and institutionalized, as scientists cannot handle the task of communicating to the general public. He reported on experiences in Germany, where regional climate change offices are established to ensure communication between scientists, local decision-makers and the public. Prof. Holz also suggested the project to use new technologies, e.g. the internet, to communicate its results, and mentioned an example from Germany, where a computer game was developed to play a risk management scenario (Odra river flood). Also activities targeted to school children, e.g. a climate change day in school, generally reach a large audience.

- Address financial aspects of mitigation and adaptation

Prof. Holz advised the project to include basic cost estimates of climate change impacts and adaptation strategies as essential information for politicians and decision-makers.

- Include the European Flood Water Directive requirements into the project activities

Prof. Holz pointed out that the European Flood Water Directive, which has to be incorporated into national law by 2009, demands systematic risk assessment, management, and stakeholder involvement for all river basins and coastal areas. The

European Flood Water Directive explicitly demands to take into account the potential impacts of climate change in establishing flood risk management plans and Prof. Holz proposed to establish cooperation between KALME and the local authorities involved in implementing the directive.

WP 8: Program management and public outreach (Andris Andrušaitis)

Besides the international ASTRA conference "Climate change and waters" in Riga May 10 – 12, 2007, KALME results were now for the second time presented at the Climate Change and Water session of the annual conference of the University of Latvia. Other visible public outreach activities included articles in local newspapers (e.g. Diena). However, the largest project success was the generation of significant new knowledge on climate change effects in Latvia, the increase in scientific capacity and cooperation, and perspective practical proposals to Latvian decision-makers.

For 2008, WP 8 will start preparing KALME's final scientific conference and will initiate a final publication, summarizing the program findings. Publication of the atlas on coastal processes is also planned for 2008. To organize an attractive final conference appears currently the most important task, together with preparing a scientific volume to document the program results. However, high quality research results will be available at the very end of the program, but preparing a high quality publication requires additional time that will then not be covered by project funding. Other activities planned within WP 8 are to arrange a PhD course and to produce a popular publication on climate change in Latvian. Also, the project will aim to give more support to integrating climate change issues into national environmental policy.

Advisory board questions and suggestions:

- Strategies for publication of project results

Project participants and advisory board members agreed that the project results should be published in peer reviewed papers. Marcus Reckermann pointed out that the BACC team plans to produce a second volume on climate change in the Baltic, into which KALME results could be integrated. Andris Andrušaitis welcomed this proposal, as publishing within an international series would increase the visibility of the project results. A book derived from the KALME project results alone would probably appear only in a local publishing house. Māris Kļaviņš also cautioned the KALME team that the final project report would not automatically be acceptable as a book. He suggested focusing on specific disciplines, e.g. aquatic biology or biogeochemistry, giving the book a concept that is attractive to attract contributions from scientists in different countries.

Additionally, a second publication would be needed to reach the general public, as Prof. Holz pointed out. This could also be achieved by a web publication, including e.g. video and animations. To ensure faster dissemination and larger public outreach to local audiences, project participants also suggested using existing Latvian internet portals, e.g. www.politika.lv.

- Advice to policy makers

Roland Bebris emphasized that the KALME project is highly appreciated by the Latvian Ministry of Environment. Especially important is the collection and description of historic information on climate change. Also for planning and assessment in the context of the Water Framework Directive, the implementation of the Nitrate Directive, and the development of the EU Marine Strategy Directive the project is a large asset. Current issues, to which the project could contribute, are the reassessment of Latvian building norms and flood protection regulations. Other areas of interests are prediction of draught frequency and scientific support for water quality assessments required by the Water Framework Directive.

According to Bebris, flood protection measures can be imposed relatively easily in Latvia, because the country is sparsely populated and legislation on protected belts and zones is already established. However, in some cases the current regulations appear to be too stringent, for example with respect to flood protection of only temporarily inhabited summer houses. Bebris pointed out that the current building norms, which are mainly inherited from the Soviet Union, are generally risk-adverse and might overestimate threats. An important issues for the Ministry of Environment is also the correct estimation of future sea level rise, especially with respect to port development e.g. in Riga.

Draughts on the other hand are currently a problem in some parts of the country. Roland Bebris emphasized that more important than the water shortage is the decrease in water quality during draught periods.

- Aim for quantitative predictions

Ilppo Vuorinen emphasized that the project should aim for more quantitative predictions of the state of biological systems. He admitted, that this goal is difficult to achieve because biological systems show higher complexity than e.g. physical systems (large number of species, changing species dominance and ecosystem function). Andris Andrušaitis added that the level of uncertainty will be high for predictions of biological parameters.

WP 9: Runoff extremes caused by climate change and their impact on territories under flood risk (Artūrs Škute)

While completing the second stage of the state research program, a study of the ecosystem complexes in the floodplain of the Daugava mid-stream was undertaken. Historical and current frequency of the repetition of extreme discharge in the Daugava was assessed, and recommendations regarding the flood risks were worked out for the involved municipalities in the Daugavpils region.

Major hydrological functions of the Middle Daugava floodplain are as follows: (1) reduction of the annual amplitude of water level fluctuation by 3-4 meters; (2) detention of the timing of the highest flood water levels in the year by 1-2 days downstream from the Dvietes floodplain; (3) interception of approximately 20 % of the Daugava daily runoff at the beginning of the floods.

In addition, the floodplain accumulates a large amount of suspended and dissolved matter, which, in turn, stimulates productivity of floodplain meadows, wetlands and lakes. Floods are regarded as an essential factor of maintaining the high biological diversity in the river floodplain ecosystems.

Using data from the Daugavpils and Jēkabpils monitoring stations, the capacity of the floodplain to store water and sediments was estimated.

Advisory board questions and suggestions:

- Is the current focus on flood risk justified?

Ilppo Vuorinen opened the discussion and asked whether higher runoff always increased sedimentation in the floodplain, or whether also the effect of reduced retention, which potentially could decrease sedimentation, should be taken into account? Prof. Holz added, that climate change perhaps will not even increase flood risks, if floods are caused by ice blockage in spring and suggested that the focus on catastrophic events, e. g. floods, is related to human psychology, which perceives climate change as catastrophic. However, Artūrs Škute replied, that top floods in the Daugava River are usually not associated with ice damming and acknowledged that climate change might not be "catastrophic" with respect to flood risk.

- Include draughts into analyses

Roland Bebris raised the question of draught risk in the Daugava River. Enn Loigu added that draughts might affect energy production by the hydropower plants on the Daugava River and therefore might even be more important than floods. Also Prof. Holz confirmed that crucial to predicting the impact of climate change might be both the frequency of draughts as well as the occurrence of flash floods. According to WP 9 results draughts have indeed become more frequent in the Daugava River over the past 20 years. Currently work on the analysis of draughts, which are generally easier to predict than floods, is in progress.

- Include the effect of a potential hydropower plant planned in Belorussia

Viesturs Jansons suggested that the work package should also address the effects of a new hydropower plant which is planned on the Belorussian part of the Daugava River. Artūrs Škute added that the potential site is located 80 km upstream of the Latvian boarder. Its impact on discharge peaks is not known yet, but could potentially be distinct. Andris Andrušaitis invited the work package to attempt comparing the effects of climate change and the potential impact of the new power plant.

Final discussion, closing of the meeting

Presentation of the KALME work packages was followed by a general discussion of the future of the program and by a round of comments to each work package. Work package specific comments were added to the respective work package section of the minutes.

KALME researchers and the advisory board agreed that the program has so far been very successful and should aim for continuation.

Date and place for the next advisory board meeting have not been set yet. However, for the next meeting, the advisory board suggested to change the order of work package presentations, finishing with WP 1.

Andris Andrušaitis closed the meeting and thanked advisory board members and KALME researchers for their input.

Annex I: List of participants:

Name, function	Position, Affiliation	Address	e-mail address
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Marcus Reckermann IAB member	International BALTEX Secretariat International Projects Department SE	GKSS-Forschungszentrum Geesthacht GmbH Max-Planck-Straße 1 D-21502 Geesthacht Germany	reckermann@gkss.de
Ilppo Vuorinen IAB member	Docent, University of Turku, director of Archipelago Research institute	Archipelago Research Institute University of Turku FIN-20 014	ilppovuo@utu.fi
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Juris Seņņikovs WP1 researcher	Faculty of Physics and Mathematics University of Latvia	Zellu Street 8 Riga, LV-1002, Latvia	jsenniko@latnet.lv
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Annex II: Meeting agenda

Thursday **8 May 2008**	
9:30-17:30 Daugavpils University	2 nd meeting of International Advisory Board, 311th auditorium,13 Vienības Street, Daugavpils University Participants: IAB members, NRP directors and managers, WP coordinators, researchers involved in WPs
09:30-10:00	***Coffee break***
10:00-10:15	Introduction: M.Kļaviņš and A.Andrušaitis
10:15-10:40	WP1 – phase 2 tasks, results, specific plans for 2008: U.Bethers (15 min. presentation +10 min. questions/comments).
10:40-11:05	WP2 – phase 2 tasks, results, specific plans for 2008: V.Jansons (15 min. presentation +10 min. questions/comments).
11:05-11:30	WP9 – phase 2 tasks, results, specific plans for 2008: A.Škute (15 min. presentation +10 min. questions/comments).
11:30-11:55	WP3 – phase 2 tasks, results, specific plans for 2008: G.Spriņģe (15 min. presentation +10 min. questions/comments).
11:55-12:20	WP4 – phase 2 tasks, results, specific plans for 2008: G. Eberhards (15 min. presentation +10 min. questions/comments).
12:20-13:30	***Lunch***
13:30-13:55	WP5 – phase 2 tasks, results, specific plans for 2008: J.Aigars (15 min. presentation +10 min. questions/comments).
13:55-14:20	WP6 – phase 2 tasks, results, specific plans for 2008: A. Ikauniece (15 min. presentation +10 min. questions/comments).
14:20-14:45	WP7 – phase 2 tasks, results, specific plans for 2008: K. Āboliņa (15 min. presentation +10 min. questions/comments).
14:45-15:10	WP8 – phase 2 tasks, results, specific plans for 2008: M.Kļaviņš and A.Andrušaitis (15 min. presentation +10 min. questions/comments).
15:10-15:40	**Coffee break**
15:40-17:30 *(may be extended if necessary and feasible)*	General discussion
19:00-	Dinner at restaurant "Lidadis" 14 Rigas Street, Daugavpils