Towards Multi-scale Modelling of the Atmospheric Environment (MUSCATEN)

Application info

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Submitted by	Marko Kaasik
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Project leader

First name	Rein
Last name	Rõõm
Gender	Male
Nationality	Estonia
Position	Professor
Academic degree	Ph.D.
Institution	University of Tartu
Telephone (work)	+3727375551
Mobile	+37253400933
E-mail address	rein.room@ut.ee

Project manager

Institution	University of Tartu
Faculty/institute	Faculty of Science Technology
Department	Institute of Physics
Institution address 1	Riia 142
Postal code	51014
City	Tartu
Country	Estonia

Administrative manager

First name	Marko
Last name	Kaasik
Position	Senior Researcher
E-mail address	marko.kaasik@ut.ee

General project info

Time span	
From date	**To date**
01.01.2010	31.12.2012
Subject area	Earth and related Environmental sciences
Natural sciences panel	Yes

Planned participants

	Research students		Other participants		Country total		
	M	**F**	**M**	**F**	**Male**	**Female**	**Total**
Denmark	5	2	5	0	10	2	12
Finland	4	6	7	3	11	9	20
Iceland	0	0	0	0	0	0	0
Norway	1	1	6	1	7	2	9
Sweden	2	2	6	3	8	5	13
Estonia	3	5	6	0	9	5	14
Latvia	2	2	3	0	5	2	7
Lithuania	1	1	2	2	3	3	6
Russian Federation	4	4	5	2	9	6	15
France	1	1	5	0	6	1	7
Total	23	24	45	11	68	35	103

Current status of research and research training within the subject area in the Nordic countries

Scientific and operational developments in both numerical weather prediction (NWP) modelling and atmospheric chemistry-transport (ACT) modelling for air pollution assessments have so far been mainly performed by separate communities, with different sources of funding and different practical goals.
The current integration of atmospheric sciences driven by common concerns on climate change, potential increased impact of hydro-meteorological hazards and the recognition by policy-makers of the important role of atmospheric sciences for environmental planning and management has generated the need for a closer collaboration, integration and synergies between these communities. This MUSCATEN-proposal aims principally at creating a scientific and training platform towards these needs and objectives, taking on board, the expertise reached by Nordic countries on these various topics to deepen, broaden and promote it.
The critical features both of NWP and ACT models, to be developed, are the description of surface-atmosphere processes and the boundary layer (BL), through which NWP models adapt to the resistance brought by the surface and interact with it as a boundary condition, and ACT models lose pollutant mass through deposition or gain it through emissions. Data assimilation (DA) is another critical methodology. Variational DA methods especially, have enabled the use of remote sensing data, leading to huge improvements in forecasting modelling systems. MUSCATEN partner institutes have contributed to the development of forecasting and data assimilation methods related to atmosphere-surface interactions (externalised surface processes system SURFEX). Such development concerns, e.g., modelling of the interactions between snow, ice, forests, lakes and the atmosphere, which are of great practical relevance for Nordic-Baltic areas. Work has also been initiated to make the HARMONIE NWP-system suitable for regional climate simulations at high resolution (a few kilometres). Running HARMONIE in NWP and climate modes will enable to study processes acting on very short-range (a few hours) to decadal time scales. A modelling system spanning such a broad time scale range implies new challenges through multi-scale feedbacks with various processes having different impact at different time scale. Such effects have so far been little investigated and this project will enable us to test developments of new parameterisations valid whatever the scale.
All partners in MUSCATEN pursue research aimed at developing different aspects of multi-scale models of the atmospheric environment, but in a scattered manner and often lacking critical mass for effective advances in the required areas of expertise. For instance, expertise on feedback mechanisms between atmospheric physical and chemical processes is concentrated at the Danish Meteorological Institute (DMI), whereas research on basic features of atmospheric aerosols is carried out at the Universities of Helsinki and Tartu.
Several preconditions for MUSCATEN were created within the Nordic Network on Fine-scale Atmospheric Modelling (NetFAM, 2005-2009). However, the links between NWP and ACT modelling (the latter being weakly

involved in NetFAM) in member teams is still insufficient for actual integrated modelling. Some institutes (e.g., LHMS) are just starting work in ACT modelling and thus need support from the more experienced partners. The number of students and researchers in atmospheric physics in each university departments (except RSHU) is relatively small, with only a few specialising in NWP-ACT modelling, not enabling highly specialised training. After the success of NetFAM, MUSCATEN is the next logical step: extending the Nordic-Baltic cooperation from mesoscale meteorological modelling to meso- and multi-scale integrated NWP-ACT modelling.
MUSCATEN partner institutes are involved in international projects beyond the Nordic countries. Research and development (R&D) in these projects are related but often funded from separate resources, which make direct cooperation between Nordic institutes difficult. Also, the overall coordination, education and exchange of information between Nordic countries on specific relevant themes is diluted in large European research programmes. For example, such programmes concentrate generally on tropospheric ozone pollution, which is much less severe at high latitudes than in Central and Southern Europe, while biogenic aerosol processes are particularly important for Nordic-Baltic countries with their wide boreal forest cover or with urban dust peaks as snow melts in spring in urban areas.
Better cooperation and more regular education events would bring substantial improvement in our understanding of the critical processes at higher latitudes and spread new knowledge from the Northern European point of view. From experience we know that a Nordic network would strengthen the already established R&D and initiate new collaborations and research applications.

An exposition of the prospects and need for Nordic co-operation within the subject area with particular reference to research training

MUSCATEN includes all leading research groups dealing with multi-scale atmospheric modelling in the Nordic countries and adjacent areas. The participating national weather services (NWS) will develop, use and implement the atmospheric research, weather prediction and regional climate modelling system HIRLAM-ALADIN-HARMONIE,. In particular, DMI provides and develops the Enviro-HIRLAM system one of the very few two-way feedback NWP-ACT models in the world, running yet in quasi-operational mode. The Finnish Meteorological Institute (FMI) provides and develops the SILAM+SALSA system and the Swedish Meteorological and Hydrological Institute (SMHI) develops the MATCH+SALSA system, with aerosol dynamics to be implemented in the ACT model SILAM by the end of 2009. MeteoFrance is the main developer of the system for surface and soil parameterisations and data assimilation SURFEX, These and other modelling tools, systems and related observational data form the basic framework for the research, development and training within MUSCATEN.
Adequate modelling of land-surface processes and air-sea (lake) interactions is necessary in order to obtain the correct partition between energy fluxes in the near-surface atmospheric layers. This becomes even more important as models increase their horizontal and vertical resolution since local atmospheric circulations are very sensitive to the surface fluxes distribution. Modelling these interactions requires detailed information about varying surface properties such as vegetation and soil types, sea and lake surface temperature, soil moisture snow and ice, etc. Observational data on these varying surface properties enter NWP and ACT models via a specific system of surface and soil data assimilation. Here, satellite observations are acquiring increasing importance, although conventional meteorological observations still form the backbone of the surface data assimilation systems for NWP models. MUSCATEN will assess the potential of various satellite sensors and products to provide new information to be assimilated into NWP-ACT model systems.
On another front, the deepening of our understanding of cloud dynamics and precipitation would allow more accurate simulations of these processes and also increases our ability to account for processes related to atmospheric aerosols. Convection and cloud processes are important for weather forecasting (especially for hydrometeorological hazards), but are also an efficient conveyer of constituents emitted close to the ground to the free atmosphere, whereby they can be ultimately transported far away from source areas. During these vertical motions and when caught inside cloud droplets, chemical constituents can undertake strong chemical transformation, changing their residence time and thus their impact on the environment. The comprehensive treatment of long- and short-wave radiation transfer in the atmosphere and at the surface is necessary in both NWP and ACT models, and is studied in several MUSCATEN member institutes. All these aspects will enable better understanding and prediction of the interactions between weather, climate and atmospheric chemical processes. In addition, as the most characteristic temporal and spatial scales affecting critical NWP and ACT processes are somehow different, investigating the interactions of these scales and how they should be incorporated in models is also a major challenge.
Finally, the specific character of Nordic conditions, such as inversion layers, boreal forests, snow cover and lake/land/archipelago landscape deserve dedicated attention and treatment in models. Especially in winter conditions, shallow stable atmospheric boundary layer (BL) over the surface is a dominating feature, determining the near-surface temperature and wind conditions and related conditions for dispersion of pollutants. Development of the theory and parameterisations for modelling this specific type of BL is a challenging task. Unique observations available within the MUSCATEN institutes (for example, the comprehensive data from the FMI Arctic observatory in Sodankylä or observations from the mesoscale Helsinki testbed) will allow validating the new developed theories and methods and applied within the network.
The atmospheric science departments of the participating universities will contribute to the model development and to researcher training in the critical areas of required expertise. These universities have strong traditions of research and education in dynamical meteorology, which forms the basis for atmospheric modelling. This NWS-University cooperation will ensure effective and coordinated training.

A detailed plan covering collaborative activities during the three years

The core aim of the proposed network is to promote Nordic scientific knowledge to the international forefront on integrated modelling and forecasting of the atmospheric environment, including weather, climate, air quality and their mutual feedbacks. MUSCATEN will be structured according to three main strands of activities:
1. Modelling the atmospheric BL and surface-related processes and parameterisations, with emphasis on NWP

applications (leading: Finland, Prof. S. Zilitinkevich).
2. Modelling atmospheric chemical composition and air quality with emphasis on up- and downscaling, and scale interaction in ACT models (leading: Norway, Dr. Michael Gauss).
3. New generation of integrated numerical weather prediction atmospheric chemical transport (NWP-ACT) model systems with two-way feedbacks, including aerosol forcing of solar radiation and cloud formation, and integrating efforts from the activities of strands 1 and 2 (leading: Denmark, Prof. A. Baklanov).

Strand 1:
Special attention will be devoted to long-living stably-stratified BLs, the snow cover and water/land heterogeneities (e.g. lakes and archipelago) common in the Arctic and Nordic latitudes, but not well described so far in current NWP and ACT models. In the surface data assimilation, we will focus on optimal use and combination of different observational sources in order to prepare a balanced initial state for operational atmospheric models. Advanced mathematical methods both for the data assimilation and forecasting systems will be developed and applied within MUSCATEN. The basic framework for Strand 1 developments will be the HARMONIE system including the SURFEX package for handling processes related to atmosphere-surface interactions.

Strand 2:
The network activity in the field of atmospheric composition will concentrate on an integrated consideration of multi-scale chemical and physical processes driving the dispersion and transformation of atmospheric tracers. MUSCATEN will bring together the groups working at city-, meso- and regional scales and benefit from global studies. The questions of particular interest will be the up- and down-scaling of chemical composition studies, multi-scale parameterizations of governing processes and interactions with NWP modelling systems at each specific scale in ACT models. The impact and features of aerosol formation processes in industrial and remote regions, especially from biogenic precursors important in the boreal environment, will be considered in connection with the climate research groups.

Strand 3:
MUSCATEN will develop a new generation of integrated NWP-ACT modelling system framework with two-way feedbacks (i.e. temporal evolution in a given parameter arising from one model is carried to the other model, and the induced changes in the parameter there are brought back to the mother model). The two-way feedbacks will especially focus on the impact from aerosol forcing of solar radiation, cloud processes and further chemical transformation of pollutants. Other aspects to investigate are integrated modelling interfaces and the online/offline problematic to assess the online/offline advantages vs. disadvantages, interfaces conditions and requirements. Specific studies of meteorological and chemical processes interactions and interactions of the ACT and NWP modelling systems at different scales will be considered as well.

The MUSCATEN networking activities will be integrated through targeted workshops and training schools addressing all the core issues:
1. Workshop/training school on modelling of snow/ice-atmospheric interactions Finland, winter 2010.
2. Workshop/training school on modelling of lake-atmospheric interactions Sweden, Summer 2010.
3. Workshop/training school on integrated NWP-ACT modelling Denmark, spring 2011.
4. Workshop on volatile organic compounds (VOC): emissions, aerosol formation, modelling Estonia, 2011.
5. Workshop on chemical composition modelling in Northern Europe Sweden or Lithuania, 2011/12.
6. Workshop/Training school on surface-related modelling and data assimilation (SURFEX) France, spring 2012.

MUSCATEN aims to cover the basic research and researcher training towards the application of these models. We plan several mutual research visits relatively to the research strands, with priority given for students. Local university courses on NWP and ACT, such as the NUMLAB course of UH, MISU HIRLAM course, the DMI Enviro-HIRLAM course and the courses of dynamical meteorology and numerical modelling of RSHU are open for participants from MUSCATEN. Such participation will be supported, in order to enrol research-oriented last-year students into multi-scale integrated NWP-ACT modelling research already within their diploma projects. An active and interactive web page, providing resources and helping to organising the activities, will be created for exchange and dissemination of information within the network as well as to promote the Nordic networking activities.

Targets to be achieved during the operating period of the network

· Exchange of experience, expertise and information as well as comparison of approaches for simulating aerosol formation processes and chemical transport modelling at various scales will promote the development of a comprehensive chemical and aerosol dynamics framework in the main modelling centres of Northern Europe.

· Implementation of the aerosol dynamics module SALSA in the SILAM model (FMI) and in the regional atmospheric chemistry and transport model MATCH (SMHI). Implementation of the secondary Organic Aerosol model for EMEP/MATCH. Both aerosol projects at SMHI are parts of the Swedish National Research Programme SCARP. At the end of the operating period, we envisage to have one or several models capable of realistically describing the mutual effects of atmospheric dynamics and atmospheric chemistry (two-way coupling) for different scales. The exchange of information and comparison of the approaches on aerosol formation processes and chemical transport modelling at various scales is important. MUSCATEN will promote development of comprehensive parameterisations of chemical and aerosol dynamics in the main modelling centres of Northern Europe.

· Further development of modelling methods for cloud microphysics as well as convective processes for different scales, including deep convection. These are needed for a realistic two-way coupling between chemistry and

cloud and radiation processes.

· Contribution to the development of the externalised surface scheme SURFEX as suitable for all the leading NWP models in Northern Europe. SURFEX will be complemented with an explicit forest description to improve its capability to simulate exchange processes over forest-dominated Nordic landscapes in relation to gases and aerosols exchange. We aim at a system capable of assimilating snow cover, lake surface temperature, sea and lake ice observations.

· Contribution to the development of the HARMONIE system, suitable not only for NWP but also for high-resolution climate simulations and ACT modelling.

· Development of personal contacts, practical training and collaboration of young researchers. The MUSCATEN framework will contribute to the production of several PhD theses. This will be supported through the workshops and training school activities listed above. These activities will enable MUSCATEN to spread knowledge and know-how outside the community of researchers, such as duty forecasters and authorities in national weather centres and environmental agencies.

Visions for continued co-operation after the grant period

The proposed network will strengthen Nordic cooperation and partly contribute to its other consortia and projects. Therefore, links established between researchers in the network will very likely continue to be fruitful also after the network period since the existing consortia offer natural umbrellas for cooperation, but on different geometries of topics. Especially, the development of a European integrated regional NWP and climate modelling system, HARMONIE, including physical and chemical processes will connect groups, which are currently working rather separately.
The proposed network will act as a platform for joint endeavours at national, international and EC levels for seeking extending possibilities of funding for joint activities, e.g. in the framework of EU and national science programmes. At present, MUSCATEN partners are already participating in different international research and operational NWP-ACT programmes: HIRLAM-A, ALADIN, CityZen, EUCAARI, GEMS, PROMOTE , COST Actions COST-728, -732, -ES0602, and -ES0603 (the last two include more than 40 groups from 25 countries, and are led by FMI). They are also involved in several long-term national research projects, e.g., SCARP (Swedish Clean Air Research Programme); IS4FIRES (FMI), Development of the Numerical Weather Prediction Towards the Forecasting of Atmospheric Environment (UT), which are on-going and planned beyond the network granting period. Direct bilateral and multilateral collaboration between the partners will continue under different forms after the network is finalised, and this would help to guarantee the availability of resources also after the network period. There exists already some planned joint research (partners FMI, NERSC, IMSIT, TTI) in the Nordplus Framework Programme - Nordic/Baltic cooperation, and the BONUS research programme.
All main Nordic modelling Groups from Denmark, Finland, Norway, and Sweden take part in the pre-operational GMES Atmospheric Service project GEMS and its successor MACC. Meteo-France has led the topic operational forecast of air quality over Europe in GEMS and will continue in MACC until 2011. Global and European research activities, such as MEGAPOLI (impact of major cities at regional and global scales), HIALINE (allergenic monitoring in Europe), and the Eurasian programme NEESPI on Earth system and climate monitoring at Northern latitudes represent dedicated efforts, which MUSCATEN can build upon.

What considerations are made to increase equal participation and equality of women and men?

There is traditionally a general bias towards male predominance in physical sciences such as atmospheric sciences. This trend is difficult to invert because research careers are demanding in term of private time and the known glass ceiling effect. Although perfect gender balance is difficult to be fully achieved, particular efforts have been devoted to include right at the start many female scientists and students and more efforts will be performed to encourage women, especially research students, to participate and be active in our network. In this way, we will ensure a more equal gender distribution for the future in this field of research.
At present, the percentage of women among members of the MUSCATEN research teams is 34%, but among research students the equal participation rate is achieved - there are 51% of women. Thus, our goal to achieve equal gender distribution of researchers in foreseeable future is realistic. In our network activities, both men and women are guaranteed equal rights and conditions in participating. In cases of insufficient resources for research visits and travels the priority will be given to women.
One specific action will be to arrange local children care in connection with the workshops and training school organised by MUSCATEN, in order to support young female scientists or students with young children.

The estimated number of research students from each country expected to participate in the network

At present, the number of research student members in the national teams is 46% of the total number of researchers involved (see details of student distribution by national teams). The total number of research students estimated to participate in the network activities during the 3-year period is about 50-60.
The students are listed below by name.

Denmark: Till Rasmussen, Ivana Cvijanovic, Ayoe Buus Hansen, Joakim Refslund Nielsen, Brian Sørensen, Allan Christensen, Leif Skovbo

Estonia: Eva-Stina Kerner, Marko Zirk, Kaarel Kimmel, Kaisa Kesanurm, Mirjam Paales, Zhihong Sun, Miguel Portillo Estrada, Leila Pazouki

Finland: Marje Prank, Joana Soares, Julius Vira, Evgeny Atlaskin, Karoliina Ljungberg, Irene Suomi, Pilvi Siljamo, Suleiman Mostamandy, Teresa Valkonen, Erik Gregow.

Latvia: Daiga Zaime, Inese Ieraga, Patric Morevs, Eduard Ruzga.

Lithuania: Adomas Mazeikis, Laura Veriankaite;.

Norway: Silje Lund Sørdal, Ivan Føre

Russia: Yakov Gontsov, Yulia Gavrilova, Anna Filippenko, Irina Petrova, Alexander Kurgansky, Ekaterina Scherbak, Edward Solodovnik, Sergey Kondratiev.

Sweden: Lisa Bengtsson, Robert Bergström, Per Dahlgren, Ulrika Willén.

Summary

The Nordic natural environment is unique in the world, with its extreme variability in time and space, its specific landscape and climatic features and thus poses a challenge for modelling and forecasting the atmospheric environment and impacts. Its specific features require high temporal and spatial resolution together with adequate descriptions of the meteorological, climatological, environmental and physiographic conditions. Understanding, describing and properly predicting the North European atmospheric variability in a holistic way is becoming possible using multi-scale coupled NWP-ACT models able to simulate all interacting physical and chemical processes (incl. aerosol microphysics) and feedbacks of the atmosphere and interactions with the underlying surface. On the other hand, this unique Nordic environment offers an excellent test bench for fine-scale models. Thus, the Nordic expertise in atmospheric modelling would make a valuable contribution to the understanding and prediction of global change processes and their impacts in specific and sensitive environmental conditions.
This Nordic network aims to cover the whole chain from basic research and researcher training towards the application of these models. The network will share modelling tools, observational and physiographic data, as well as computing and educational resources, in order to strengthen the expertise in coupled NWP-ACT atmospheric modelling in the Nordic countries and adjacent areas around the Baltic Sea. The network combines research groups from the leading universities and national weather services of the area. A special effort will be devoted to the support, advising and monitoring of the training, mobility, communication/dissemination skills and research of young scientists in order to enhance their career profile.

Project leader's CV

Name: Rein Rõõm
Date of birth: 10/17/1945
Phone: +372 737 5551 , +372 53 400 933
E-mail: rein.room@ut.ee

Career

Institution and position held.
2008 - ... University of Tartu, Faculty of Science and Technology, Institute of Physics, University of Tartu; Professor.
2002 - 2007 University of Tartu, Faculty of Physics and Chemistry, Institute of Environmental Physics; Professor.

1998 - 2001 University of Tartu, Institute of Environmental Physics, visiting professor.
1995 - 2001 Tartu Observatory (TO) , Head of the Department of Atmospheric Physics and Head of the Group of Dynamic Meteorology.
1993 - 1997 University of Tartu , Professor of the Joint Chair of Dynamic Meteorology.
1989 - 1995 IAAP, Deputy director, head of the group of dynamic meteorology.
1983 - 1992 Tartu University (TU) , Chair of Geophysics, Lecturer (0.25 load).
1983 - 1989 IAAP, Senior research associate.
1973 - 1983 IAAP, Junior Research Associate.
1972 - 1973 Institute of Astrophysics and Atmospheric Physics of the Estonian Academy of Sciences (IAAP), engineer.

Education.
1964 - 1972 Tartu University, Faculty of physics and chemistry, physicist.

Administrative responsibilities.
1996 - ... Estonian representative in the HIRLAM Advisory Committee.
1993 - ... President of the Estonian National Committee to IUGG.

Research activity

Degree information.
Rein Rõõm, Doctor's Degree, 1980, (sup) O. Avaste, T. Viik, Radiative field in planetary atmosphere at anisotropic scattering, Tartu Observatory (ENSV TA AAI).

Field of research.
Natural Sciences and Engineering, Geosciences (Numerical methods of weather prediction and climate research, theoretical problems of atmospheric physics).

Current grants and projects.
Buoyancy wave dynamics and wave drag in the stratified atmosphere with shear wind.
Development of the Numerical Weather Prediction Towards the Forecasting of Atmospheric Environment.
Database of Estonian Atmosphere 1965-2005.

Project leader's list of publications (maximum 20 titles)

Viik, T., Rõõm, R. (2008). Radiation field in a semi-infinite homogeneous atmosphere with internal sources. Journal of Quantitative Spectroscopy & Radiative Transfer, 109, 363 - 377.

Rõõm, R.; Männik, A.; Luhamaa, A.; Zirk, M. (2007). Nonhydrostatic semi-elastic hybrid-coordinate SISL extension of HIRLAM. Part II: Numerical testing. Tellus Series A-Dynamic Meteorology and Oceanography, 59, 661 - 673.

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Room, R.; Miranda, PMA.; Thorpe, AJ. (2001). Filtered non-hydrostatic models in pressure-related coordinates. Quarterly Journal of the Royal Meteorological Society, 127, 1277 - 1292.

Kaasik, M.; Room, R.; Royset, O.; Vadset, M.; Soukand, U.; Tougu, K.; Kaasik, H. (2000). Elemental and base anions deposition in the snow cover of north-eastern Estonia - The impact of industrial emissions. Water Air and Soil Pollution, 121, 349 - 366.

Room, R. (1999). Least action principle for a general, non-hydrostatic, compressible, acoustically non-filtered pressure-coordinate model. Quarterly Journal of the Royal Meteorological Society, 125, 1903 - 1907.

Room, R.; Mannik, A. (1999). Responses of different nonhydrostatic, pressure-coordinate models to orographic forcing. Journal of the Atmospheric Sciences, 56, 2553 - 2570.

Room, R. (1998). Acoustic filtering in nonhydrostatic pressure coordinate dynamics: A variational approach. Journal of the Atmospheric Sciences, 55, 654 - 668.

Rõõm, R. (1996). Free and rigid boundary quasigeostrophic models in pressure coordinates. Journal of the Atmospheric Sciences, 53, 1496 - 1501.

Room, RJ. (1990). General from of the dynamic equations for the ideal atmosphere in the isobaric coordinate system. Izvestiya Akademii Nauk SSSR Fizika Atmosfery i Okeana, 26, 17 - 26.

Veismann, U.; Rõõm, R.; Avaste, O. (1984). Remote sensing of the atmosphere from scientific stations "Salyut". Advances in Space Research, 4, 93 - 98.

Ryym, RI. (1974). Some properties of light-absorption and scattering on 2-layered mie particles with absorbing nucleus. Izvestiya Akademii Nauk SSSR Fizika Atmosfery i Okeana, 10, 434 - 439.

Rõõm, R.; Ülejõe, A. (1996). Nonhydrostatic acoustically filtered equations of atmospheric dynamics in pressure coordinates. Proceedings of the Estonian Academy of Sciences. Physics. Mathematics, 45, 323 - 330.

Rõõm, R.; Kaasik, M. (1996). Research into atmospheric dynamics at Tartu Observatory. Proceedings of the Estonian Academy of Sciences. Physics. Mathematics, 45, 331 - 338.

Rõõm, R. (1994). A quasi-geostrophic model with temperature and ground surface pressure in the role of basic fields. Proceedings of the Estonian Academy of Sciences. Physics. Mathematics, 43, 102 - 117.

Pihl, A., Rõõm, R. (1992). On the possibility of determination of microphysical parameters of noctilucent and mesospheric clouds from twilight remote sensing measurements from space. Atmospheric and Oceanic Optics, 5, 734 - 738.

Rõõm, R. (1991). Distribution-density function of a two-dimensional vorticity field and integrals of motion . Proceedings of the Estonian Academy of Sciences. Physics. Mathematics, 40, 112 - 114.

Groups

Denmark (DK)

The Danish national team consists of the Danish Meteorological Institute (DMI; www.dmi.dk) and the University of Copenhagen (UoC; www.gfy.ku.dk/). The team is lead by Dr. Bent Sass (DMI; bhs@dmi.dk; Ph +45-3915-7436; Fax +45-3915-7400) with researchers Profs. Alexander Baklanov (DMI) and Eigil Kaas (UoC); Drs. Alexander Mahura and Ulrik Korsholm (DMI). Sass is head of the Meteorological Research Division, leading HIRLAM (www.hirlam.org) model developments in DMI. Baklanov is senior scientist, leader of FP7 EC MEGAPOLI project (www.megapoli.info). Kaas is Prof. of Meteorology and Climate Dynamics at UoC; director of the Centre for Energy Environment and Health (www.ceeh.dk). Mahura and Korsholm are senior scientists. The team includes 7 research students and 5 researchers.
DMI is the national meteorological service for Denmark, Greenland, and Faroe Islands; has a long-lasting experience in atmospheric modelling including development, running and analysing 3D atmospheric models for both operational use and research in weather forecast, climate change and environment. DMI possesses powerful supercomputers (from Oct 2008 - Cray XT5) that allow operational and experimental NWP simulations with high spatial resolution.
UoC has a long research tradition in developing new numerical techniques for improving of atmospheric dynamics and transport models; has a world leading role in studying effects of Greenland ice core, climate research aiming at understanding and modelling past climate variations. Team is the main developer of integrated Enviro-HIRLAM system; has experience in a wide range of developments to HIRLAM including physical parameterizations (radiation scheme, condensation and convection schemes, aerosol feedbacks, etc.); modelling of ABL; ACT on local, regional, and global scales; atmospheric aerosol dynamics; chemical weather forecasting; numerical weather prediction; climate and geophysical fluid dynamics, and its numerical methods. Team members participated in the Danish national, international and EU-funded projects (HIRLAM, Enviro-HIRLAM, ETEX, GEMS, ENSEMBLE, COST-715, -728, AR-NARP, FUMAPEX, Enviro-RISKS, CEEH, MEGAPOLI).

Estonia (EE)
The national team of Estonia consists of the Institute of Physics, University of Tartu (UT), the Estonian Institute of Meteorology and Hydrology (EMHI) and the Institute of Agricultural and Environmental Sciences, Estonian University of Life Sciences (EMU).
The leader of the team is Prof. Rein Rõõm (UT, rein.room@ut.ee, Ph +372 7375551, fax +372 7375556), with researchers Dr. Marko Kaasik (UT), Dr. Aarne Männik, M.Sc. Andres Luhamaa (EMHI), Prof. Ülo Niinements and Dr. Veljo Kimmel (EMU). There are 6 PhD students and 2 MSc students involved.
UT is the leading national institution in research and education on atmospheric dynamics and atmospheric aerosols. The activities are based on the national project Development of the Numerical Weather Prediction Towards the Forecasting of Atmospheric Environment, (2008-2014). UT is also involved in EC FP7 project EUCAARI and relevant COST-728, -0602, -ES0603 Actions; and participates in developing the atmospheric environment modelling systems SILAM and Enviro-HIRLAM.
EMHI is a governmental institution subordinate to the Ministry of the Environment, responsible for weather forecast and maintaining the weather observation network. EMHI is running the HIRLAM model operationally and a high-resolution non-hydrostatic version of HIRLAM in quasi-operational mode.
EMU is the main national centre of agriculture- and forestry-related education and research. In particular, it is carrying out research on emissions of biogenic VOC-s (known as aerosol precursors) and effects of atmospheric pollution to the vegetation, e.g. excessive fly ash loads in some areas of Estonia.

Finland (FI)
The Finnish team consists of the Finnish Meteorological Institute (FMI; www.fmi.fi) and of the Division of Atmospheric Sciences, University of Helsinki (UH; www.atm.helsinki.fi). The team is led by Prof. Hannu Savijärvi (UH; Hannu.Savijarvi@helsinki.fi; Ph +3589 1950857) with as senior members: Profs. Sergej Zilitinkevich (UH and FMI), Sylvain Joffre (FMI) and Jouni Pulliainen (FMI). Savijärvi has been the coordinator of the NordForsk network NetFAM (2005-2009). He has a long experience in numerical modelling of planetary atmospheres. Joffre is the head of the FMI Meteorological Research, Zilitinkevich leads the EU ERC programme "PBL-PMES - Atmospheric planetary boundary layers: physics, modelling and role in Earth system", Pulliainen is the head of FMI Arctic Research. In addition, 10 research students and 10 researchers of UH and FMI are estimated to participate in the team.
The Meteorological Research Dept. at FMI is responsible for the development of NWP models and related applications. The FMI Air Quality Dept. develops dispersion models coupled with NWP models. UH is responsible for basic research and the training of researchers and professionals in meteorology and atmospheric physics in Finland. Ongoing research within the Finnish team addresses several topics of interest of the suggested network, including assimilation of snow and lake observations in a NWP model, studies of the atmospheric-surface interaction, parameterisation of radiative fluxes, studies on chemical transport and air pollution (ACT), application of NWP results for wind energy studies and sea wave modelling. Observational data from the FMI Arctic Research Centre in Sodankylä from the Helsinki Testbed and other observational campaigns are available for the participants of the suggested network. The computing resources of FMI can be used by the visitors from the suggested network. The FI team can provide guidance in the use of the NWP and ACT model systems and data.

France (FR)
The national team of France consists of Météo-France (MF) - French national meteorological service and Obervatoire Midi-Pyrénées-Laboratoire dAérologie. The team leader for the project is Eric Bazile (Eric.Bazile@meteo.fr; Ph: +33561078468; Fax: +33561078453) - senior scientist at the research centre of MF. The team includes: Eric Martin - head of the team involved in atmosphere-surface-hydrology interactions research; and senior scientists: Jean-Francois Mahfouf (responsible for the surface analysis for SURFEX) and Patrick Le Moigne (responsible for the development and management of the SURFEX system). In addition, 2 research students and 1 researcher from the Obervatoire Midi-Pyrénées-Laboratoire dAérologie are planned to be involved in the network.
MF participates actively in several European projects, including HIRLAM, EUMETNET, GMES, and

ENSEMBLES. MFs research center (CNRM-GAME; 250 researchers) plays a leading role in the international community, especially in the fields of climate research and atmospheric modelling. MF uses several NWP models: the global ARPEGE-IFS model developed jointly with ECMWF, the LAM model ALADIN over Europe developed with the ALADIN-Group and recently the NH-model, AROME (2.5 km horizontal resolution) in collaboration with the University of Paul Sabatier (Department of Aerology).

Latvia (LV)

The national team of Latvia consists of the Institute of Mathematical Sciences and Information Technologies, University of Liepaja (IMSIT) and the Transport and Telecommunication Institute (TTI). The team leader is Prof. Sharif Guseynov (IMSIT, TTI; sh.e.guseinov@inbox.lv, Ph +371 22341717; Fax +371 634 24223; 14 Liela iela, Liepaja LV3401, Latvia). The team includes Profs. Janis Rimshans (IMSIT; rimshans@mii.lu.lv) and Eugene Kopytov (TTI; kopitov@tsi.lv, Ph +371 7100590; Fax +371 7100660; 1 Lomonosov Str., Riga LV-1019, Latvia) and 3 research students.

IMSIT is the leading national institution in research and education on mathematical physics, numerical analysis and mathematical modelling. Activities are connected to the national projects High Performance Computing Methods for Environmental and Traffic Flow Dynamics and Stable analytical and numerical solution technologies for inverse problems deterministic and probabilistic systems investigation (2007-2008). Rimshans (IMSIT) was involved in the Nordic Grid Neighbourhood Network: Boundary Layer Phenomena Over Partially Ice Covered Arctic Seas: Impact on Weather, Climate, Ecology, with as Supervisor Prof. Sergej S. Zilitinkevich, Division of Atmospheric Sciences, Dept. of Physical Sciences, University of Helsinki, Finland, (2005-2007).

The Transport and Telecommunication Institute (TTI) is the leading national largest university-type technical institution in research and education on Computer Science and Information Technologies, Electronics and Telecommunications, Transport, and Logistics. TTI encompasses the Laboratory of Applied Software System (high-performance computers cluster; parallel programming), the Department of Mathematical Methods and Modelling, the Department of Mathematics and Physics, the Department of Software Engineering and the Institute of Telematics and Logistics.

Lithuania (LT)

The national team of Lithuania includes the Department of Hydrology and Climatology, the Vilnius University (VU, www.hkk.gf.vu.lt), the Siauliai University (SU, www.su.lt) and the Lithuanian Hydrometeorological Service under the Ministry of Environment of the Republic of Lithuania (LHMS, www.meteo.lt). The team leader is Ass. Prof. Gintautas Stankunavcius (VU, gintas.stankunavicius@gf.vu.lt, Ph +370-5-2398292; Fax +370-5-2398292). The team includes Ass. Prof. Ingrida Siauliene (SU, ishauliene@gmail.com) and researchers: Kristina Mockeviciute (LHMS NWP group, k.mockeviciute@meteo.lt) working on topics of forecast verification methodology and validation tools, Martynas Kazlauskas (LHMS NWP group, martynas@meteo.lt) working on implementation of pre-operational/operational NWP systems (HIRLAM) at LHMS, and HIRLAM system administration.

The Department of Hydrology and Climatology at VU is focusing on climate research, atmospheric pollution modelling, lake hydrology, climate effects on the hydrosphere.

SU coordinates the airborne pollen monitoring network in Lithuania and has long experience in identifying pollen and describing ongoing processes. The university is participating in EU-funded projects ECO-HOUSE, COST ES0603, HIALINE. LHMS is a governmental institution responsible for meteorological (including aeronautical and marine) and hydrological observations and forecasts, provides hydrometeorological information for Lithuanian institutions, enterprises and organizations and it is an associated member of the HIRLAM-A programme.

Norway (NO)

The national team of Norway consists of the Norwegian Meteorological Institute (met.no; met.no), Nansen Environmental and Remote Sensing Center (NERSC, http://www.nersc.no/main/index2.php), and Department of Geosciences at University of Oslo (UiO, http://www.geo.uio.no/). The team leader is Prof. Thor Erik Nordeng, Senior Scientist at met.no (met.no; t.e.nordeng@met.no; Ph +47 2296 3305; Fax +47 2296 3050). The researcher team members are Drs. Michael Gauss, Knut Helge Midtbø, Viel Ødegaard, and Mariken Homleid (met.no); Prof. Jon-Egill Kristjansson (UiO); and Dr. Igor Esau (NERSC). In addition, 2 research students and 4 researchers from met.no and UiO will participate in the network.

The Research Department at met.no consists of approximately 70 scientists working in the area of atmospheric sciences focusing on numerical modelling at all scales, oceanography, air pollution ranging from the regional (European) scale to the local (city) scale and on the use of observations in data assimilation with emphasis on objective analysis of remotely sensed data and software developments. The team participates and contributes in the HIRLAM cooperation and its model development work but has in addition a team working with high resolution non-hydrostatic models capable of resolving the km-scale dynamics: the Unified Model of the UK and WRF model for complex topography.

UiO. In connection with the IPY-THORPEX project, there is an effort to enhance the capability of NWP models to accurately simulate polar lows and other Arctic weather phenomena. The effort involves the use of non-hydrostatic models (WRF and UM) at high resolution, focusing on the role of physical processes and their treatment in the models. This work is partly carried out in collaboration with other members of the IPY-THORPEX cluster. The group is also a partner in a Nordic Centre of Excellence, led by Prof. Markku Kulmala (Helsinki University). The most important modelling tools for these activities are the Oslo CTM2 Chemical Transport Model and the NCAR CCSM coupled climate model.

NERSC is an independent non-profit research institute affiliated with the University of Bergen, Norway. NERSC has about 50 staff members and conducts basic and applied environmental research funded by national and international governmental agencies, research councils and industry. NERSC's vision is to make a significant contribution to the understanding, monitoring and forecasting of the world's environment and climate on regional and global scales. NERSC's research strategy is to integrate the use of remote sensing and field observations with numerical modelling through the use of advanced data assimilation techniques. The project infrastructure

includes the new supercomputer facility CRAY XT4 at the University of Bergen to run the turbulence-resolving model, data sets at the NERSC and available through the NERSC projects network.
The Norwegian team will focus its work in particular on surface processes, which now is moving towards an integrated approach to data assimilation and parameterizations. Externalized surface models are used for both, and this also highlights the need to work with consistent interfacing between surface and atmosphere modelling. At high latitudes the problems related to treatment of snow and ice are responsible for important errors in NWP forecasts. The planned work with physio-chemical processes is another area of special interest and in particular the effects of aerosols in the modelling of clouds and condensation.

Russia (RU)
The national team of Russia consists of the Russian State Hydrometeorological University (RSHU; www.rshu.ru), the Voeikov Main Geophysical Observatory/Air Pollution Modelling and Forecasting Laboratory (MGO/APMFL; www.mgo.rssi.ru) and the North-Western Roshydromet (Hydrometeorological Centre of Saint-Petersburg, SPbH, www.meteo.nw.ru). The team is led by Prof. Andrey Belotserkovskiy (RSHU, vice-rector, belotserkovsky@rshu.ru; Ph +7-812-444-38-12; Fax +7-812-444-60-90). The other members are Profs. Eugene Genikhovich (MGO/APMFL) and Sergey Smyshlyaev (RSHU), Drs. Ekaterina Kourzeneva and Anastasia Senkova (RSHU). In addition, 12 research students and researchers of RSHU, MGO/APMFL and SPbH will participate in the network.
Ongoing research within this team mainly addresses the following topics: 1) Parameterization of lakes and analysis of lake variables; 2) Surface description and physiographical databases; 3) Boundary layer parameterization; 4) Snow parameterization and data assimilation; 5) Parameterization of radiation, especially in the surface layer; 6) Dispersion modelling in local and regional scales; 7) Assessment of the environmental and health impacts in local and regional scales; 8) Downscaling of meteorological fields governing dispersion processes in the atmosphere; 9) Atmospheric chemistry; 10) On-line and off-line atmospheric-chemical-aerosol modelling; 11) Implementation and testing of atmospheric chemistry-physics feedback mechanisms.
RSHU is the leading educational centre in meteorology, hydrology, oceanography and ecology in Russia. RSHU activity is supported by the National Programme The Development of the Scientific Potential of the Higher School funded by the Ministry of Education and Science of Russia. RSHU cooperates with HIRLAM, ALADIN and COSMO consortia, with the Rossby Centre; participates in international projects (INTAS, MEGAPOLI) and national projects in cooperation with the Institute of Numerical Mathematics of the Russian Academy of Science. A comprehensive theoretical course on dynamical meteorology and numerical atmospheric modelling, including atmospheric chemistry, is being lectured at RSHU; educational materials are being updated to include up-to-date knowledge.
MGO/APMFL is the leading Russian scientific centre working on atmospheric diffusion theory, air pollution modelling/forecasting and corresponding problems in geophysical hydrodynamics and boundary-layer meteorology. The MGO/APMFL cooperates with scientists from the Finnish Meteorological Institute; the Catholic University of Louvain (Belgium); the National Environmental Research Institute (Denmark), and the Goddard Space Center (USA).
SPbH is the centre for weather and climate forecasting of North-Western Region of Russia. SPbH cooperates with the HIRLAM consortium taking part in several national projects together with Hydrometcenter of the Russian Federation, run MM5 and WRF models in operational and pseudo-operational modes.

Sweden (SE)
The national team of Sweden consists of the Swedish Meteorological and Hydrological Institute (SMHI; www.smhi.se), the Department of Meteorology at the University of Stockholm (MISU; www.misu.su.se) and the Department of Earth Sciences at the University of Uppsala (MIUU; www.met.uu.se). The team leader is Dr. Patrick Samuelsson (SMHI; Patrick.Samuelsson@smhi.se; Ph +46 11 4958614; Fax +46 11 4958001). Patrick Samuelsson is a member of the Rossby Centre at SMHI; responsible for the development of land-surface processes in the Rossby Centre Regional Climate Model and is active in SURFEX development. The senior members are Drs. Colin Jones, Karl-Ivar Ivarsson, Per Undén, and Stefan Gollvik (SMHI); Profs. Michael Tjernström and Gunilla Svensson, Dr. Annika Ekman (MISU); and Ass. Prof. Anna Owenius Rutgersson (MIUU).
SMHI is a government authority subordinate to the Ministry of the Environment. SMHI offers products and services in the fields of meteorology, hydrology and oceanography for general weather forecasts, customised forecasts, analyses, surveys, statistics, expert opinions and reports, climate studies and research. Activities of the Air Quality research unit include modelling of atmospheric dispersion, chemical and physical transformations and deposition of substances from local to hemispheric scales. Activities of the unit for meteorological analysis and forecasts focus on development of NWP models and data assimilation which is integrated in the European cooperation programs HIRLAM, ALADIN and HARMONIE. Activities of the climate modelling research unit, Rossby Centre, include advanced climate modelling, model evaluation and climate analyses, impact studies, supercomputing and communication.
MISU is the nationally leading meteorological university unit in Sweden. MISU has a strong atmospheric numerical modelling tradition that goes back to when C-G Rossby was the professor and conducted the very first operational numerical weather forecasts in the 1950's. Today, it employs researchers in regional modelling both for forecasting and dynamic downscaling, with a special expertise in model physics (parameterizations) concerning boundary-layer and meso-scale dynamics, clouds and aerosols. MISU also has a strong tradition in Arctic meteorology.
MIUU is focusing on different aspects of micrometeorology (boundary layers, surface fluxes and turbulence), in particular on air-sea interaction.

Budget

	2009	2010	2011	Total
Expenses				
Travel expenses	110 000	110 000	110 000	
Living expenses	150 000	150 000	150 000	
Honoraria	0	0	0	
Administration (max 10 % of the grant)	30 000	30 000	30 000	
Material	10 000	10 000	10 000	
Other	0	0	0	
Section totals	300 000	300 000	300 000	
Period totals	300 000	300 000	300 000	900 000

Please include specific information on the various items in the budget, and eventual own resources (incl 30% of the Baltic part of the concrete project activity costs). Note that a maximum of 10% may be used for direct administrative costs.

As a basic assumption, for one person, an average travel cost (boat, train, plane) per visit is estimated to be 1700 NOK; with 300 NOK per diem to be paid during the visit or a corresponding amount used by the host for daily expenses; during long visits, 2 4 weeks, the cost of accommodation is 1400 NOK per week. During training courses the cost of accommodation is 350 NOK per day; during short visits the cost of hotel accommodation is 700 NOK per day. It is estimated that about 2/3 of travel and living expenses will be spent for workshops and training schools and 1/3 for mutual visits. A typical short visit will last 3 days and cost 4300 NOK, a typical long visit will last 2 weeks and cost 7300 NOK. Thus, the network will accommodate 40 50 visits, nearly half of them short-term and half long-term ones.

The 30% of funding for the Baltic part will be covered:
Estonia national project Development of the Numerical Weather Prediction Towards the Forecasting of Atmospheric Environment and research grants of Estonian Science Foundation (UT) , also budgetary funding of EMHI;
Latvia budgetary funding of IMSIT and TTI;
Lithuania - Lithuanian National Science Foundation (SU and VU), and state budgetary funding of SU, VU, and LHMS.

For funding of Russian participants, cooperation with several international programmes is foreseen, for instance COST and TEMPUS. Relevant training schools and workshops would be organised jointly with COST, with actions ES0602 and ES0603 for instance. Visits of Nordic partners to well-known centres of expertise RSHU, MGO and MF will be encouraged.