EUROCORES Programme
European Collaborative Research

Biogenic Volatile Organic Compounds in the Carbon - Chemistry - Climate system : present, past, and future Projections (EuroVOC^4)

DRAFT Call for Outline Proposals

What is EUROCORES?

The ESF European Collaborative Research (EUROCORES) Programmes offer a flexible framework for researchers from Europe to work on questions which are best addressed in larger scale collaborative research programmes. The EUROCORES Programmes allow excellent researchers from different participating countries to collaborate in research projects 'at the bench'. They also allow, when appropriate, colleagues from non-European countries, for example the US, to participate. The Programmes encourage and foresee networking and collaboration of researchers to achieve synthesis of scientific results across the programme, to link to related programmes, and to disseminate results.
EUROCORES Programmes allow national research funding organisations in Europe and beyond to support top class research in and across all scientific areas, by matching the needs articulated by the scientific community with their strategic priorities.
Funding decisions on the projects and the research funding remain with the national research funding organisations, based on international peer review operated by ESF. ESF also provides support for networking the researchers and for the scientific synthesis of research results and their dissemination[(1)]. This way, the EUROCORES Scheme complements the EC Framework Programme and other collaborative funding schemes at European level.

For further information see:
http://www.esf.org/eurocores

[(1)] Currently supported through a contract with the European Commission under the Sixth Framework Programme (EC Contract no. ERAS-CT-2003-980409).

Biogenic Volatile Organic Compounds in the Carbon – Chemistry – Climate System: present, past, and future (EuroVOC^4)

Following agreement with funding organisations in # *countries,* the European Science Foundation is launching a Call for Outline Proposals for Collaborative Research Projects (CRPs) to be undertaken within the EUROCORES Programme EuroVOC^4. EuroVOC^4 will run for 3-4 years and it includes national research funding, as well as support for networking and dissemination activities provided by the ESF. The Programme aims to support high quality multidisciplinary research.

Outline Proposals are to be submitted by **9th May 2008**. It is expected that Full Proposals will be invited by 30th June 2008 with 15th September 2008 as expected deadline for submission.

A Programme-specific website can be consulted for the latest updates at **http://www.esf.org/eurovoc4**

Rationale

Biogenic Volatile Organic Compounds (BVOC) play a critical role in biosphere-atmosphere interactions, and are key constraints of the physical and chemical properties of the atmosphere and climate. An estimated 500 to 1000 Tg of carbon are emitted annually from the vegetation as BVOC, dominated by isoprenoids and methanol. Such a high rate of emission implies a large metabolic cost and hence a very important plant functional role for these compounds. BVOC can be emitted by plants constitutively, or the emission may be induced in response to biotic and abiotic factors. Both constitutive and induced BVOC sometimes act as defensive compounds and are often crucial for plant protection in stressful environments.

In the presence of nitrogen oxides, BVOC are the main precursors of photochemical ozone (O_3) production in the troposphere, where O_3 acts as a potent greenhouse gas. At current concentrations the O_3 radiative forcing is of near-equal magnitude to that of methane, making it the third largest contributor to anthropogenic warming. This number is highly uncertain since observations and simulations suggest that the pre-industrial O_3 burden may well have been lower than current background levels, resulting in significantly larger radiative forcing calculations. In addition to being a greenhouse gas, O_3 is also a toxic pollutant that significantly reduces crop and forestry yield world wide and is responsible for health problems during pollution episodes. O_3 phytotoxicity may significantly accelerate future climate warming due to reductions in the terrestrial carbon sink.

Once emitted into the atmosphere, the oxidation of BVOC also affects the levels of radicals and hence the oxidizing capacity of the atmosphere and in particular the OH radical which is the cleansing agent for many atmospheric pollutants. In light of this property, BVOC emissions from vegetation or emissions of VOC from biomass burning help explain trends in glacial-interglacial atmospheric methane concentrations and thus contribute to climate change during the Holocene but the exact mechanisms and nature of the interactions involved are being disputed. BVOC also affect atmospheric composition via their oxidation products which contribute to the growth of secondary organic aerosol (SOA) particles. Such particles are climatically important through scattering and absorbing solar and thermal radiation, by acting as cloud condensation nuclei (CCN), thereby affecting cloud properties and precipitation or by serving as reaction sites for heterogeneous chemistry in the whole troposphere.

Yet despite their recognized and wide significance in ecology, in the climate system and for atmospheric composition, the knowledge of biotic and abiotic control of BVOC emissions can only be called rudimentary. Consequently, the spatial and temporal variation in BVOC emissions and their responses to changes in vegetation cover, the terrestrial carbon cycle and climate are regarded as one of the chief uncertainties for projections of the past, present and future role of the terrestrial biota in the Earth System and the related feedbacks.

Scientific goals

The overall objective of EuroVOC^4 will be to provide informed knowledge on the biochemical, physiological and ecological controls of BVOC emissions and their interactions with atmospheric processes. Of particular importance are the roles played by biological (e.g., herbivory, developmental stage, plant metabolism and gross primary productivity), environmental (e.g., atmospheric CO_2 concentration, O_3 levels and other oxidative stress) and climatic (e.g., temperature, precipitation, water stress) variables. EuroVOC^4 aims to investigate, based on experimental work, satellite data and modelling studies, the species-specific, ecosystem, regional and global BVOC emission patterns in past, present and projected future climates. It will investigate the impact of BVOC on regional pollution episodes, on the atmospheric composition evolution and on the radiative forcing of climate, through the formation of secondary organic aerosol and other mechanisms. EuroVOC^4 will also provide the basis to assess the related regional and global climate and chemistry feedbacks on emissions in a coupled biosphere-atmosphere system. A strong interdisciplinary collaboration is required for this type of research that covers e.g., biological, physical, chemical and meteorological science aspects over a broad range of time and space scales. All terrestrial ecosystems and all volatile organic compounds of biogenic origin will be considered. Because of its differing sources and atmospheric reactivity are methane emission studies beyond the scope of this call, but methane can be considered as part of a larger, integrated biosphere-atmosphere feedback proposal.

Research topics

Proposals for Collaborative Research Projects (CRPs) that address one or more of the research areas described below should focus on exploring and understanding the coupling of BVOC emissions and atmospheric processes. Submission of interdisciplinary projects is encouraged involving groups of scientists from at least three participating countries who have proven expertise in this field and who have access to appropriate research facilities. EuroVOC^4 projects are open to laboratory studies, field campaigns, use of satellite data and numerical experiments with both bottom-up and top-down modelling techniques. Participation of female and of young scientists at project coordinator level is encouraged. Scientific excellence and relevance to the EuroVOC^4 goals will be the chief criteria for selection of projects.

To address the objectives outlined above, the programme will focus on the following topics:

1. Physiological control on BVOC emissions
Recent research has largely rewritten the metabolic map for the formation of plant isoprenoids, a class to which the majority of BVOC belong. The discovery of a second isoprenoid pathway in the chloroplast has led to major advances in our knowledge of the roles of photosynthetic electron transport and carbon assimilation in supplying precursors for isoprenoid biosynthesis. However, despite carbon assimilation and electron flow providing the main precursors, environmental constraints may uncouple isoprenoid emission from photosynthesis and shift the control of the emission to other drivers. Even less is known about the biosynthesis and regulation of other BVOC including methanol, carbonyl-compounds and green-leaf volatiles. Molecular tools, including the use of transgenic plants with altered BVOC emission, now make it possible to further understand the control and regulation of BVOC biosynthesis by permitting the identification of key enzymatic steps, regulatory proteins, hormones and signalling pathways.

While regulatory studies have been carried out on some aspects of BVOC formation, much more needs to be done. Technological advances should be exploited to elucidate biosynthesis of many other reactive molecules of major importance in plants and in the atmosphere. Knowledge of BVOC biosynthesis and regulation is a key task to be able to implement parameterizations, process-based modelling, and plant response to the environment. Molecular studies can be expected to concentrate on model species possessing extensive genetic and genomic resources, but efforts should also be made to study the regulation of BVOC biosynthesis in a range of plant taxa including woody species responsible for major BVOC emissions. Furthermore, knowledge of processes obtained in laboratory experiments must also be tested with field grown plants to confirm its validity under realistic environmental conditions both at leaf and ecosystem scale. In combination with detailed mathematical cellular modelling the observed variation can be expressed in a quantitative manner.

2. Emission of BVOC in response to the environment and to abiotic constraints. Evidence has recently emerged of a complex BVOC emission response to abiotic constraints that goes well beyond 'traditional' variation in response to temperature and light. Important additional variations in emission rates are introduced by changes over the growing season, in response to day-to-week weather history or in response to water stress. Their quantification, and relation to biochemical controls is a major challenge that EuroVOC[4] addresses. For some BVOC a general inhibition of their production as atmospheric CO_2 concentration increases was suggested while no coherent picture has yet emerged on the interaction of BVOC emissions and oxidants, for instance ozone, or other soil and airborne pollutants. The discovery that some BVOC protect plants against abiotic stresses (elevated temperatures, oxidative stresses) has further stimulated interest to understand biochemical and physiological mechanisms accounting for this effect, and to exploit this desirable feature biotechnologically.

In this context it is crucial to account for the difference between the short-term (e.g., hours) and medium to long term (e.g., days to seasons, or longer) effects of environmental drivers. This includes episodic, extreme, events which may become more frequent with climate change. Integrated long-term research is also needed, at biochemical, physiological and ecological level, and where applicable, using large scale infrastructures, to determine and understand the combined effect of climate change on BVOC biosynthesis and emission, and the feedback caused by the environmental control on constitutively emitted BVOC or the BVOC-mediated plant defence against biotic and abiotic constraints.

3. Climate change and the influence of BVOC-mediated plant responses on enemies and mutualists

BVOC play critical roles in plant interactions with a range of friends and foes by serving as attractants, deterrents, toxins and arrestants. For example, constitutively emitted BVOC are important orientation cures for a range of animals and microbes. After herbivore feeding or egg laying on plant foliage, complex BVOC blends are often released which repel herbivores directly and attract predators and parasitoids that attack herbivores and their eggs. BVOC released from damaged leaves may also act as internal cues to stimulate the production of defences in neighbouring tissues and even alert other plants in the vicinity to the presence of herbivores causing changes in their patterns of growth and resource distribution. Floral BVOC, on the other hand, are powerful lures for pollinators and other arthropod visitors and hence important components of the trophic chain.

This important area of research investigates how diverse BVOC-mediated interactions not only help plants survive and reproduce, despite the presence of multiple enemies, but also how the web of BVOC communication could be an essential feature in stabilizing natural ecosystems. Clearly, manipulation of BVOC emission has enormous potential to improve yield in agriculture and forestry applications by maximizing production of seeds and fruits that rely on pollinators and minimizing herbivore damage. Additionally, altering production of BVOC involved in internal signalling could modify plant responses to a variety of stresses. To realize the potential of BVOC emission, however, it is critical to assess the impact of changing climatic factors and anthropogenic pollutants on the production, emission and perception of BVOC. This calls for more research that explores the roles of BVOC emission in the interactions of plants with herbivores, herbivore enemies, pollinators and pathogens, especially under environmental constraints that are predicted to become more problematic in the future.

4. Present and future BVOC emissions and its effects on tropospheric chemistry and air pollution

BVOC are important precursors to O_3 formation in high NO_x environments. O_3 formation is one of the few atmospheric processes where even today and even in highly populated regions the contribution from BVOC is of equal magnitude, or even dominates over combustion VOC sources. O_3 is not only a greenhouse gas but also a toxic pollutant that reduces crop yields and the terrestrial carbon sink in general, with possibly large indirect radiative forcing effects. Biogenic

secondary organic aerosols (SOA) constitute a substantial fraction of PM10 even in urban areas and is therefore important also in terms of air quality.

Future BVOC emissions are highly uncertain: these will be stimulated by warmer temperatures and enhanced gross primary productivity, but reduced by the possible CO_2-inhibition. Human land use and land cover changes will be a further factor of overriding importance.

The net effects of a full land cover-climate-CO_2-BVOC-O_3 interaction on present and future atmospheric chemistry and climate are unknown. EuroVOC[4] aims to meet this challenge by manipulation studies and by global simulation experiments that not only investigate the single contributing factors but, crucially, quantify these also in an interactive framework. New process understanding on what controls BVOC emissions and their atmospheric reactions must be included in such simulations. Increasing efforts should also target model evaluation using available observations. Progress in computational infrastructure increasingly allows investigation of climate-emission-chemistry feedbacks in fully coupled simulation frameworks. Importantly, EurVOC[4] will foster novel land use and land cover projections as important components of such studies to account, e.g., for effects of biofuels on emissions and their feedbacks to chemistry and climate.

5. Interactions of BVOC emissions and secondary organic aerosols in the climate system

SOA grow via condensation and heterogeneous reactions of low-volatility BVOC oxidation products. The fourth assessment report of the IPCC emphasises how anthropogenic perturbation to natural aerosol properties remains a major uncertainty in the estimate of radiative forcing caused by human beings. To better understand the processes of SOA formation, not only the regional BVOC emission patterns but also the BVOC-SOA yield and chemistry must be better quantified and understood. This is the case particularly for very reactive BVOC that are known to be important aerosol precursors but that are so reactive as to be difficult to detect once emitted from the plant (e.g., sesquiterpenes). Additionally, the effect of BVOC emissions of large carbon mass, but with low probable SOA yield (e.g., isoprene) needs further investigation. Furthermore, it has been shown that enhanced anthropogenic oxidants tend to increase biogenic SOA formation; these links are important in assessing the overall SOA formation.

EuroVOC[4] intends to contribute to significant progress in understanding BVOC-CO_2-SOA-climate interactions. This can be achieved by studying SOA production in controlled experiments that emulate realistic emissions and environmental conditions, and to co-investigate SOA formation and BVOC emissions in field experiments with emphasis on accurate quantification of emission rates of BVOC that are major contributors to aerosol formation. Impacts of climate change, as well as of biotic stress (e.g., induction of BVOC in response to herbivory) on SOA production are a chief area of uncertainty. An important focus lies also in quantifying the existence of possible BVOC-SOA-temperature or precipitation feedbacks in the future atmosphere that accounts for effects of increasing CO_2 concentration on BVOC emissions.

6. Holocene variation of BVOC and VOC fire emissions and their effect on palaeo-atmospheres and climate

BVOC react readily with atmospheric oxidants like the hydroxyl radical ($OH^{\cdot}$). In that way they constrain concentrations of CH_4 since the latter also reacts with the same oxidants. Atmospheric chemistry model calculations yield a much reduced concentration of CH_4 when BVOC emissions are excluded since more oxidants are available for the breakdown of CH_4, significantly reducing its lifetime. This may help to explain long-term trends in CH_4 observed in ice-cores which is difficult to do based solely on modelled changes in CH_4 emissions. But in the same way, BVOC emissions from vegetation fires have also been discussed as having an important effect on atmospheric chemistry and climate over the Holocene. The interplay of methane emissions and variation in its atmospheric sink that are caused due to either emissions of BVOC from vegetation or from fire are an unresolved issue. Likewise, simulated pre-industrial O_3 and SOA burdens are highly sensitive to assumptions on BVOC and fire emissions and their calculated anthropogenic radiative forcings may change considerably if a better process understanding of past emissions is taken into account.

EuroVOC[4] provides the research environment to meet this challenge by simulation experiments that investigate the interactions of palaeo-climate, vegetation and fire emissions and their effects on the palaeo-atmosphere. Understanding emission-chemistry-climate feedbacks are a major objective. Moreover, the influence of early human agriculture has not been quantified: deforestation and slash and burn agriculture as Holocene human civilisations spread across the globe may have greatly affected emissions well before the industrial revolution. EuroVOC[4] will thus produce greatly improved simulations of pre-industrial atmospheric CH_4, O_3 or aerosol particle burdens which are crucial for assessments of human impact and anthropogenic pre-industrial to present radiative forcing.

7. The effects of changes to BVOC emissions resulting from land use chqnge and management

Land use and land cover change and management of vegetation can have significant effects on BVOC emissions. For instance, replacement of forest by herbaceous crops or forest plantations will change the type, quantity and seasonality of emissions drastically. Important examples include emission bursts in response to harvesting. Growing of plants in monocultures may increase susceptibility to herbivore damage which may lead to increasing BVOC emissions.

Biofuels are widely supported as an option to reduce fossil fuel consumption, and in many countries the climate potential for woody biofuel crops, including short rotation coppice of willow or poplar, Eucalypt or Oil palm plantations is estimated to increase. However, these commonly planted species for short-rotation forest crops and biodiesel have very high isoprene emission potentials that exceed those of native, mixed forests greatly. If planted in a high NO_x environment their emission effects on air quality may run counter to their positive effects on energy supply. The effects of land cover and land use change in view of climate, BVOC emission, whole carbon budget, and regional O_3 formation therefore deserve further study.

Human activities and climate change can influence the frequency of fire which has several important implications for BVOC-related research. Fire releases a large amount of VOC directly and also affects emissions indirectly via changes in vegetation composition. BVOC production in turn influences the flammability of vegetation.

An integrated research approach is required to assess the effects of land use and land cover on emissions and the related chemistry and climate feedbacks at all temporal and spatial scales.

8. Novel technologies to investigate BVOC emissions

Measurements and simulations of BVOC on all time and space scales covered in EuroVOC[4] are crucial to improve our understanding of the emission process. Transgenic plants that differ in levels of BVOC biosynthetic enzymes have emerged as state-of-the art tools to investigate processes within the plant. Advances in mass spectrometry are facilitating real-time measurements of emissions and isotopic fractionation studies. While these measurements are increasingly being linked to measurements of other functional traits (e.g., leaf photosynthesis, respiration, growth and stress resistance), changes in emissions from leaves and canopies have not been followed over a growing season on a regular basis. Micrometeorological methods like disjunct eddy covariance techniques are being tested at a number of field sites to measure BVOC fluxes above ecosystems. Seasonal to longer-term observations are encouraged also as a means for model evaluation. The necessary theoretical framework (i.e., within canopy reactions, footprint analyses for chemically reactive species) is in the early stages of development. Top-down models for regional to continental BVOC emission estimates have been proposed that combine satellite-derived information and atmospheric chemical transport models, while at the same time a number of novel bottom-up modelling approaches have emerged that seek to quantify emissions from plant to global level in a process-based way.

The objectives of EuroVOC[4] encourage the combination of a range of methodologies. This could, for instance, include field campaigns on a range of space scales, controlled laboratory experiments that are designed to develop and evaluate process-based models or the combination of bottom up with top down model experiments.

Guidelines for applications

(Outline and Full Proposals)

Collaborative Research Project (CRP) proposals from individual scientists or research groups eligible for funding by the organisations participating in the Programme will be accepted for consideration in the EUROCORES Programme EuroVOC[4].
Scientists or groups not applying for or not eligible to apply for funding from these organisations (including applicants from industry), can be associated with a proposal where their added scientific value is demonstrated. Their participation as Associate Partners in a project must be fully self-supporting and will not be financially supported by the participating funding organisations.

Proposals are only eligible, if they fulfil the following **criteria**:

- Proposals must involve, as a minimum, three eligible Principal Investigators (PIs) from **three different countries.**
- A maximum of 50 % of the Individual Projects (IPs) in a Collaborative Research Project (CRP) can come from one country.
- Proposals must involve more PIs than Associated Partners

Applications should normally be for three years although applications for shorter or longer time periods may be considered depending on the rules of the participating funding organisations. Taking into account the selection and approval processes, the successful projects are expected to begin their activities in **March 2009**.

Online submission of applications

Outline and Full Proposals will be submitted online. Applicants should follow the proposal structure as indicated in the application template for outline proposals available on the Programme website at: **http://www.esf.org/eurovoc4**.

On this Programme website, links to information on national funding eligibility and requirements as well as to a EUROCORES Glossary and Frequently Asked Questions (FAQs) are available.

Prior to submitting Outline Proposals, all applicants <u>have to</u> contact their national funding organisations in order to verify eligibility and to ensure compliance with their relevant organisations' granting rules and regulations (see contact persons listed on page 8).
At the time of online submission of the Outline Proposals, the Project Leader is asked to confirm this on behalf of all the participants in the CRP.

Outline Proposals

Outline Proposals are invited by 9th May 2008.
Outline Proposals will be examined by the participating funding organisations for formal eligibility. Therefore, it is crucial that all applicants contact their national funding organisation prior to submitting their proposals.
In compliance with the rules and regulations of the participating national funding organisations, the requested funds under the EUROCORES Programme EuroVOC[4] can include salaries for scientific and technical staff, equipment as well as travel costs and consumables within the project, specifying the amount requested from each Funding Organisation. National policies may also require the proposal to contain additional specific information. Applicants should be aware that the participating funding organisations can make significant adjustments to the requested funds in order to bring these in line with their rules and regulations.

Applications will be assessed according to a set of criteria in a two-stage procedure, as to ensure a thorough selection of scientifically excellent proposals. At the outline stage, the Review
Panel will select proposals with potential for scientific excellence, by applying the following criteria:

- Relevance to the Call for Proposals
- Novelty and originality
- European added value (scientific)
- Qualification of the applicants

An Outline Proposal submitted must comprise:

- A short description of the CRP (max. 1200 words, including objectives, milestones, methodologies (for example experiments and fieldwork);
    - Short description of how (and why) the partners contributing to the CRP will work together;

- Short CVs of Project Leader (PL), all PIs and Associate Partners (max. one page each, including five most relevant publications);
- Estimated budget (consistent with the rules of relevant national funding organisation) tabulated according to a provided template.

Associated Partners (APs) are also considered part of a CRP and will be assessed as such at both the Outline and Full Proposal stage.

It will be assumed that arrangements for the handling of IPR (Intellectual Property Rights) will be in place within projects, following the applicable national legislation and national funding organisation rules. Applicants are strongly urged to have such arrangements in place, covering all research groups (including any associated groups) before the start of the projects. It is expected that the results obtained by the projects supported under this EUROCORES Programme will be placed in the public domain.

It is also expected that all relevant clearance of other national or international committees (for example ethics) has been obtained before funding is granted. It is the responsibility of applicants to clarify any such matters (if applicable) with their national contact points.

Full Proposals

Full Proposals will be invited following the recommendations of the Review Panel. The deadline for full proposals will be announced later, but is expected to be around 15th September 2008.

Please note that only applicants who submitted an Outline Proposal can submit a Full Proposal.

For the Full Collaborative Research Project (CRP) proposals, the most important selection criterion is "Scientific quality". Other criteria include interdisciplinarity (according to the scope of the call), qualification of applicants, level of integration and collaboration, feasibility and appropriateness of methodologies, European added value and relation to other projects (risk of double-funding and track record for collaboration).

The Full Proposals will be assessed by at least three independent external expert referees who are selected by the ESF from a pool of scientists suggested by the participating funding organisations and the Review Panel. A list of all referee names used for the international peer review will be published once the selection process is complete.

After receiving all referee reports, they will be made available (anonymous) to the applicants for their information and for commenting (optional). The Review Panel will rank all Full Proposals based on the assessment of the Full Proposal, the anonymous referee reports and the applicant's responses to these.
The Review Panel will create a ranked list consisting of the best Full Proposals and will subsequently make recommendations to the Management Committee for the funding of these proposals. The actual granting of the funds to the Individual projects on the ranked list will depend on the total amount of funds available in each country by the participating Funding Organisations. The use of funds in a project will be subject to the rules and regulations of each participating Funding Organisation as well as to the national laws of those countries.

Full proposals must include a well-argued scientific case (both for the collaboration envisaged and for the individual contributions), a list of participants, a detailed tabulated budget and other supporting information. A single, common scientific case must be made throughout the proposal to demonstrate an aim for scientific synergy and integration of multinational expertise. In addition, the amount requested from each national funding organisation has to be clearly and separately specified. Detailed instructions on requirements and how to complete the application forms will be made available once Full Proposals are being invited.

The **Project Leader** will be the main CRP proposal contact point for ESF for the duration of the project. He/she will be responsible for representing the Collaborative Research Project, for its participation in programme activities, and for any reporting requirements placed on the project as a whole.

All **Principal Investigators** will be responsible for dealing with the requirements attached to the contributions of their own funding organisation.

Programme Structure and Management

Programme Structure

The overall responsibility for the governance of the programme lies with a *Management Committee*, whose membership is formed by one representative from each participating funding organisation (usually a senior science manager) together with an ESF representative.

Proposal assessment and selection are the responsibility of an international, independent *Review Panel*. The members of this panel are leading scientists, appointed by ESF following suggestions from participating Funding Organisations. The membership of the Review Panel will be available on the Programme website for information. The Review Panel is also expected to monitor the overall scientific progress of the programme.

The Scientific Committee which is formed by the Project Leaders of all funded CRPs will be responsible for proposing networking activities for scientific synergy in the EUROCORES Programme. They will also advise and support the EUROCORES Programme Coordinator in the coordination of networking activities.

Programme Networking

Networking activities are designed to strengthen the science objectives of this EUROCORES Programme by promoting coherence in the activities of the science community involved. This will provide the European added-value which is the central objective of any EUROCORES Programme.

Networking and collaboration within EUROCORES Programmes takes place at two levels:

1. between the various Individual Projects within each Collaborative Research Project (CRP) and
2. between the funded CRPs within the programme as a whole.

The intra-CRP activities are supported through the research grants each participant receives from the participating funding organisations in the given CRP. The cross-CRP activities are funded through contributions to the EUROCORES Programme.

The intra-CRP collaboration is motivated by the nature of the CRP's research objectives, i.e., by the scope and the complexity of the questions it deals with. In a CRP, the participating groups have the opportunity to gather the required critical mass to successfully address the objectives and challenges of their project.

The cross-CRP networking and collaboration is stirred by the aims and the nature of the particular EUROCORES Programme. The theme which was the basis of this EUROCORES Programme has been selected for its clear need of collaboration in the proposed field. The funded CRPs will collectively set up and further streamline this new collaboration. To this end, the CRPs will engage the programme participants and, when of clear benefit, colleagues from outside the programme in joint activities such as:

- Working Group meetings for the exchange of information and results across the CRPs;
- Joint scientific meetings or summer schools;
- Short term visits;
- Development and delivery of joint training schemes;
- Seminars, Workshops, symposia, invited sessions either stand-alone or as part of other larger events;
- Common web-facilities and publications.

Through active participation of scientists in the above mentioned activities, not only existing collaborations are enhanced but new and strategic partnership opportunities are also identified.
Furthermore, these activities may provide opportunities to explore aspects of the programme which are not covered by the funded research projects.

The integrative activities between the CRPs will help to strengthen the field by building coherence within this emerging research community and will serve as a platform for the research work which is done in the programme.

Project members are expected to participate annually in at least one cross-CRP activity.

When submitting your proposal, please note that the costs for networking within your CRP should be budgeted for in your proposal. Funds for networking between the CRPs will be centrally managed by the ESF through contributions from the participating funding organisations.

Programme evaluation

A Mid-Term evaluation, conducted by the Review Panel, will evaluate the overall progress of the Programme, based on the progress of the funded CRPs. Here, the Review Panel has a steering function and can comment on the CRPs' work plan in relation to the objectives of the overall Programme. A final evaluation will assess the achievements of the whole EUROCORES Programme.

Contacts in the participating organisations

As it is currently not known which Funding Organisations will support this programme, please contact your National Funding Organisation or Research Council to inquire about this programme.

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