

Investigation of how research in the Department of Geology, the Department of Physical Geography and Ecosystem Science and the Centre for Environmental and Climate Science can be coordinated and organised within a single department

Summary

The review team believes that there is great potential in merging Geology, INES and CEC into one department in terms of research, infrastructure, teaching and administration, without compromising the networking interdisciplinary approach. The prerequisite for a successful merger is that there is a clear vision and objective on the part of the faculty, which should be communicated to the staff concerned.

There are both opportunities and risks in a merger and therefore we propose that the faculty decides to start a preparatory work with the aim of forming a joint department. In order to lead this work, it is of utmost importance to identify suitable persons trusted by the staff. It is also important that the employees concerned are involved in the merger process, including through a number of working groups to address key issues before a final decision is taken. Issues to be discussed include, for example, subject profiling, the name of the new department, the focus of the research groupings, the organisation of the infrastructure, review of the graduate subjects, development of the undergraduate education, location aspects, etc. A group should also review the potential transfer of researchers to a new department from other departments, in particular the Biology Department. The work of these groups must take its time, but not be too lengthy, suggesting a maximum of one year.

As a starting point for these discussions, we envisage a common department with the following structure. All activities will be co-located and the former departmental division will be broken up and replaced by new research groupings where every researcher will have the opportunity to feel a sense of belonging. The research groupings should operate in a collegial spirit, but

should not have financial autonomy or decide on recruitment. The network activities belong to the department, but have their own budget for their activities. In order to maintain its strong interdisciplinary identity, we propose that it retains the name Centre for Environmental and Climate Science (CEC). It should also be located close to researchers working interdisciplinarily to strengthen the link between research and networking. Otherwise, the department is organised according to the rules of procedure of the faculty, i.e. led by a head of department and a relevantly staffed board, etc.

An absolutely crucial issue for the successful consolidation of a new department is a head of department and a board that has the confidence of the staff, is responsive but at the same time clear in its decisions. The faculty should ensure that suitable people are available to fill these positions. In order to further demonstrate transparent leadership, it is important to form a consultative body with representatives of the various research groups and networks. This preparatory body, the Strategic Research Council, should focus on profiling strategies, including the targeting of new research hires.

Base administration should be co-located to optimise skills and strengthen redundancy. Research coordinators and research information officers should be co-located and close to the relevant research activities. In order to share experience and knowledge, the technical staff should be organised in a working group, but localisation may be organised according to needs. For example, a joint department will be responsible for high quality research infrastructures and the technicians should be located according to their responsibilities.

An organisational change of the dimension we are discussing here means anxiety for the staff and significant additional work during the transition period. In order to facilitate this work and ensure a smooth implementation, resources need to be made available, both to compensate for lost working time, but also to strengthen the operations with strategic new recruitments.

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Introduction

In a world of rapid environmental and climate change, there is now a strong belief in, and expectation of, academia to contribute to science-based societal change to meet high-level environmental, climate and sustainability goals (such as the SDGs/Agenda 2030 and the Paris Agreement/Net-0). As a result, there is a rapidly growing interest in developing and strengthening the type of research that can be a fundamental basis for meeting these goals. There is also a relatively high level of external funding available for research in this area. There is a common conception that this research need to be cross-disciplinary and interdisciplinary, and therefore many universities in Sweden, the EU and the rest of the world are investing in coherent research on the environment, climate and sustainable development. The Faculty of Science at Lund University has two departments and one centre, all of which are strong in geoscience and environmental science research; the Department of Geology (Geology), the Department of Physical Geography and Ecosystem Science (INES) and the Centre for Environmental and Climate Science (CEC). The management of the Faculty of Science has an ambition to merge these units, and the present report is the result of an external study with the task of analysing how research in these units can be coordinated and organised within a common department, and how the environmental and climate field at the Faculty of Science can thereby be profiled more clearly.

State universities in Sweden are public authorities whose main tasks are research, education, cooperation and information. All university employees thus contribute to the development of the society of the future by increasing knowledge in a wide range of areas. Common to internationally outstanding universities, which rank high in international league tables, is both breadth and excellence in a wide range of subject areas. This can only be achieved through collaboration at different levels. Multidisciplinary research groups whose expertise lies in linking researchers and research results in different fields must be given as much opportunity to develop as groups with excellence in certain, sometimes narrow, core subjects. Organisation is key to achieving this. It must be stable in the long term, yet flexible enough to foster excellence and adapt to societal challenges. A sub-optimal university, or faculty, can often be likened to a "research hotel" with isolated clusters often lacking closer collaboration with each other.

Traditionally, the organisation of universities is based on faculties, which in turn comprise departments where most of the core activities are carried out.

The activities of a department are usually led by a department head, who chairs a departmental board where major decisions are taken on research and teaching, usually concerning the financial priorities of the department. At Lund University, the departments are organised directly under eight faculties. As in several of the country's universities, Lund University also uses the centre form of organisation. Nationally, the centre form has often been used to create a strong research or teaching environment, often in interdisciplinary areas, which have no clear home in the departmental structure. Such centres usually have a strong external base-funding and often extensive collaboration with activities outside the academy. Centres may also be established around research infrastructures. In most of the country's universities, centres are organisationally linked to one or more departments, but they may also be independent and function more as research institutes, or in a matrix organisation that cuts across the university's traditional line organisation. The way staff are employed at a centre differs, often depending on the long-term plan of the centre. However, academic staff are often employed by departments, while administrative staff are employed directly by the centre.

Nationally, the organisation of geoscience and environmental science research varies somewhat among the country's major universities. In Uppsala and Umeå, for example, the field is grouped under a single department: the Department of Earth Sciences and the Department of Ecology, Environment and Earth Sciences respectively (in Uppsala there are also several biological departments). The University of Gothenburg has three departments; one for Earth Sciences, one for Biological and Environmental Sciences, and one for Marine Sciences, all belonging to the Faculty of Science. At SLU there is a Department of Soil Sciences linked to soil and forestry research, which also includes elements of biology at the process level. Environmental issues, organismal biology and biodiversity are handled by a number of departments, belonging to several faculties, usually focusing on either the forest or agricultural sectors. Finally, Stockholm University has adopted a structure where the Faculty of Science has four sections; Biology, Earth and Environmental Sciences, Chemistry, and Mathematics-Physics. Each of these sections is headed by a section dean. Within the Geological and Environmental Sciences section there are three departments: the Department of Geological Sciences, the Department of Environmental Sciences and the Department of Physical Geography. Stockholm University also has environmental science centres such as the Stockholm Resilience Centre and the Baltic Sea Centre, and the Bolin Centre for Climate Research.

Mission

The Dean has decided to appoint a group of external experts with the task of analysing, based on existing activities within CEC, INES and Geology, how research within these units can be coordinated and organised within a joint department in a 3–5 year perspective, and how the environmental and climate field at the Faculty of Science can thereby be profiled more clearly. This analysis will take into account the processes of coordination that are already underway and also consider the elements of research in the environmental and climate field that are conducted at related units and departments within the University, primarily at Biology but also at other units within the Faculty of Science and LTH. The status and future development opportunities of research will be analysed from both a national and international perspective. On the basis of this basic analysis, the investigation will make proposals for:

- How research activities at INES, Geology and CEC can be organised and located within a single department.
- Which subject areas should be prioritised for new faculty recruitment in a new department.
- How the research infrastructure at INES, Geology, CEC, and Biology can be better managed and coordinated. Such a proposal should take into account both local infrastructure and the national research infrastructure ICOS Sweden.
- How the administrative support functions at INES, Geology and CEC can be strengthened and made more efficient through increased cooperation within a joint department.

The investigation will be based on self-assessments and interviews with staff directly involved (INES, Geology and CEC) and related departments/units.

The investigation will draw as much as possible on the work and analysis carried out within RQ20.

The analysis and the proposals shall not be constrained by the current organisation or location of the activities. It shall take into account the proposals of the separate investigation regarding the organisation of the CEC networking activities and the hosting of the BECC and MERGE.

Background information on the units

The Department of Geology has, in general, had a well-defined subject area with a quaternary geology and a bedrock geology component for a long time.

The department moved around to different premises until 1930, when it moved to Sölvegatan 13 for a longer period. Activities expanded and parts of the Quaternary Geology Department moved to Tornavägen in the 1960s. Plans to build a dedicated Geocentre were made in the 1970s, but never implemented.

INES (Department of Physical Geography and Ecosystem Science) has its origins in the Department of Physical Geography where, together with the geologists, an initiative was taken in the 1990s to develop and strengthen the research area of ancient climate–present climate–climate change. This led in 2000 to the establishment of a Centre for Geobiosphere Science. Part of the plant ecology research activities moved in 2001 from the then Department of Ecology to the Department of Physical Geography, which was given its current name in the process. In 2003, the formerly geographically dispersed activities of INES were co-located with Geology in the partly newly built, partly renovated, Geocentrum (now Geocentrum II), where INES and Geology are mainly located today. In 2010, the two departments merged to form the Department of Earth and Ecosystem Science but were dissolved again a year later to once again become two separate departments. However, they still have a common administrative unit, the CGB office, with a common administrative head.

In connection with the merger of the departments, the joint doctoral subject Geobiosphere Science was formed with specialisations anchored in geology and physical geography and ecosystem science respectively. There is still a certain degree of joint postgraduate training, with INES and Geology having a joint FU committee and a common overall subject title of Geobiosphere Science, but in recent years there has been a move to more clearly separate the two departments' postgraduate training. The departments currently each have a director of studies for postgraduate studies. On the undergraduate side, Geology has a GU committee where the department's Director of Undergraduate Studies is the convenor, while INES has only a Director of Undergraduate Studies.

Like the other departments, both INES and Geology are managed by a board chaired by the head of department. Geology is divided into two departments, Quaternary Geology and Bedrock Geology. At INES there is a GIS Centre which appears to be a distinct unit within the department, but INES otherwise lacks distinct departments.

CEC was established in 2010 as a centre at the Faculty of Science with the aim of facilitating, bringing together and giving visibility to interdisciplinary research and education in the field of environment and climate. In practice, this meant an evolution of the activities of the Department of Environmental Science Education, which was now incorporated as a unit within the CEC. The two Strategic Research Areas (SRAs) BECC (Biodiversity and Ecosystem Services in a Changing Climate) and MERGE (Modelling the Regional and Global Earth system), both of which were awarded in national competition, were also linked to the CEC, and involve collaboration between Lund and Gothenburg Universities (BECC) and Lund and Gothenburg Universities, Linnaeus University, Chalmers, KTH and the Rossby Centre at SMHI (MERGE), respectively. CEC's activities grew rapidly and several LU-joint initiatives in the field of environment and sustainability have come to be linked to CEC. Both through its mission (decided by the faculty) and through associated activities, CEC has developed an important networking (and faculty-wide) role to initiate, support and collaborate on interdisciplinary and multidisciplinary research in the climate and sustainability field.

Originally, the design of the centre meant that administrative staff would be employed at the CEC, while research and teaching staff would mainly belong to the departments and be coordinated through the CEC in research, training and collaboration. Today, there is a core of academic staff who contribute to the management of the CEC and associated activities, but also academic staff who are attached to the respective departments to varying degrees. However, as a result of its mission and activities as host and hub for a number of collaborative initiatives and the two SRAs, the Centre has evolved into a complex organisation that differs markedly from a typical department. The research and networking activities are in many ways closely linked and difficult to separate, with networking activities and community contacts based on very close links with ongoing research on, for example, land use and biodiversity.

The CEC is governed by a Board of Governors, appointed by the Faculty Board of Science. Formally, the CEC does not have a head of department but a director, but the role is very similar to that of a department head. Under the Director there are four Deputy Directors responsible for undergraduate education, postgraduate education, research, and collaboration. These tasks are largely carried out in collaboration with a number of different departments, including INES and Biology. Administrative activities are managed by an

administrative manager. As a consequence of its mission and its many networking and collaborative functions, the CEC has very developed communication activities led by a Communication Officer. For the same reason, it also has a more extensive administrative capacity in terms of finance and coordination. The extensive organisation of the CEC's network elements is not further addressed in this context, as these elements are the subject of a separate investigation.

Staff

Geology

The Department of Geology has 58 employees and 52.3 FTEs, excluding PhD students. Of these, six FTEs belong to the CGB office, which serves both Geology and INES. The summary of staff categories below therefore presents the CGB office separately. (The summary shows FTEs and the data refer to December 2021.)

Professors:	9	Post docs:	2	Res. engineers:	7,3
Lecturers:	9	Adjuncts:	1	Admin. staff:	3,5
BUL:	0	Researchers:	12,6	Technical staff:	1,9

CGB Office

Admin. staff: 5

Techn. staff: 1

INES

INES has 90 employees and 79.6 FTEs, excluding PhD students, broken down by staff category as shown in the table below (the table shows FTEs and the data refer to December 2021).

Professors:	8,1	Post docs:	5	Res. engineers:	3,5
Lecturers:	12,3	Adjuncts:	4	Admin. staff:	10,5*
BUL:	2	Researchers:	27,2	Techn. staff:	7

* Incl. 1 FTE research coordinator

CEC

The Centre has 66 staff and 56.2 FTEs, excluding PhD students, broken down by staff category as shown in the table below (the table shows FTEs and the data refer to December 2021).

Professors:	3	Post docs:	8,8	Res. engineers:	3,9
Lecturers:	2,3	Adjuncts:	1,2	Admin. staff:	20,2*
BUL:	1	Researchers:	14,8	Techn. staff:	1

* Of which about 15 are directly linked to network activities

Summaries of the evolution of staff categories over a five-year period can be found in Annex 1.

Economy

The faculty allocation to Geology and INES follows the faculty allocation model, while CEC is not part of the faculty model but is allocated funds in a specific order, with the largest allocation under the SRA framework. Overall financial statistics for the three units over the last five years are provided in Annex 1.

Although there is a significant difference in the amount of external funding between the three departments, the difference becomes marginal when broken down by the number of persons employed as professors, associate professors, assistant professors and researchers (Table 1).

Table 1. Appropriations (in 2022) and grants (funds for the years 2016-2020) and total examination for the years 2016-2020. All amounts in kSEK.

	Undergrad. education	Research & postgraduate education	External grants	External grants per researcher ^a	Degrees, doctorate & licentiate
INES	13 927	30 111	46 591	832	32,5
Geology	10 807	30 440	28 434	862	21
CEC	13 493 ^b	38 676 ^c	22 837	993	24

a The sum of professors, associate professors, assistant professors and researchers.

b Much of the basic training is provided by teachers employed outside the CEC

c Some of these funds are allocated to other units, such as parts of the SRA (26,631 kSEK)

Research

The Department of Geology has two divisions, Bedrock Geology and Quaternary Geology, which can generally be said to encompass two major research areas. The Department has further subdivided into eight more delineated research areas, with geochronology, i.e. methods for determining the ages of geological materials, forming a common thread throughout. Geochronological research is one of several areas of strength at the Department where the laboratories for 14C dating, luminescence dating, dendrochronology and paleomagnetism, which have been built up for various geochronological methods, form a base and have meant that an extensive

research network has been built up over the years. The department's research covers a wide range of geological disciplines, from bedrock geology, historical geology and palaeontology to quaternary geology, palaeoceanography and palaeoclimate, and biogeochemistry. This breadth is a strength in itself and means that it has a greater capacity than most other geological departments in the country to provide, for example, a comprehensive geological education and to address societal challenges where expertise on the whole Earth system is necessary. There should be great potential for increased collaboration between research areas within the department as well as with INES and CEC. However, published work shows that such collaboration is currently relatively limited.

Within INES there are a number of defined research areas such as biogeophysics and climatology, biogeochemistry, ecosystem ecology and geographic information science. The research is generally of high international quality and successful in terms of publications and external funding and is largely carried out in collaboration with national and international collaborative partners. There are also aspects focusing on numerical modelling, with particular reference to the development of ecosystem models and their applications at regional and global scales, also including modelling of soil biogeochemistry. The development and adaptation of agriculture and forestry in a changing climate is also being studied. More process- and observation-oriented research focuses on the land-atmosphere exchange of greenhouse gases, reactive trace gases and aquatic biogeochemistry in boreal environments and the effects of environmental and climatic changes on terrestrial, atmospheric and aquatic processes. There is also a link between observations and models, where observations are used to improve the description of processes in ecosystems and climate models. At the interface between infrastructure and research is the GIS Centre, where research aims to understand and describe ecosystems at different scales in space and time using optical remote sensing and spatial modelling using GIS.

The researchers employed at the CEC have a mixed background, often coming from different natural sciences but also from social sciences and humanities. Researchers often work in an interdisciplinary manner, across disciplinary boundaries, across faculties and between academia and society. Overall, CEC has accumulated strong expertise in interdisciplinary environmental research. Consequently, the research associated with the CEC is far more extensive than the list of staff suggests. The research carried out by staff employed at the

CEC is thus not as disciplinarily coherent as in regular departments. The research interests of the three professors can be briefly described as studies of geochemical processes in the biogeochemical cycle in soil and water, greenhouse gas exchange processes, and landscape ecology and sustainable land use. The research groups of the three lecturers broaden the palette to include ecotoxicology and exposure studies, strategic management of green spaces, and risk and decision analysis and management of uncertainties in scientific assessments.

CEC coordinates and manages the funds for the two strategic research areas BECC and MERGE, which bring together major interdisciplinary research groups on issues of biodiversity and ecosystem services in a changing climate (BECC) and climate modelling (MERGE) respectively. Within the CIG constellation, INES has extensive collaboration in CEC research projects, particularly in MERGE, while geology is a minor player in the CEC arena. Outside the CIG constellation, the Department of Biology is the main home for CEC researchers and research at the Faculty of Science. Within biology, the research groups in biodiversity and conservation science are mainly active within CEC, but also researchers in evolutionary ecology, microbiological ecology and aquatic ecology.

All three units are highly successful in their research, both nationally and internationally, and attract substantial external funding. The RQ20 study points to several strong environments with good publication and access to high quality research infrastructure, and also to considerable research collaboration between all three units, although this could be improved. The initial bibliometric studies carried out at the Faculty confirm this picture. For the CEC, RQ20 also points to the potential for increased collaboration with LUCSUS (Lund University Centre for Sustainability Studies; a social science-oriented centre for sustainability studies).

Research infrastructure

Lund University hosts the Swedish nodes of both ICOS and ACTRIS, two national infrastructures of crucial importance for climate and atmospheric research not only in Sweden but also internationally through the large European networks of which both infrastructures are part. ICOS is today mainly under CEC, while important associated activities are organised under INES (Carbon Portal). Research of relevance to ICOS is carried out at CEC, INES and to a small extent also at Geology. ACTRIS is organisationally located at LTH. Riksrigger is a national infrastructure for deep geological

drilling currently linked to the Division of Engineering Geology within the Department of Biomedical Engineering at LTH. It is a relevant infrastructure for parts of the activities within Geology.

Some other activities are also at the interface between research and infrastructure; an example of such an activity is EO-GIS (remote sensing and geoinformation) within INES, where methodology development and applications are close to ICOS activities.

In all three units (CEC, INES, Geology) there is extensive use and operation of small and medium-sized local infrastructures, examples of which are the IR and Raman spectroscopy labs (CEC), electron microscopy and ICP-MS labs (Geology), the dendrochronology lab (Geology), measuring stations in Africa (INES) and the laboratories for 14C dating, luminescence dating, and paleomagnetism (Geology). At present, part of the Geology infrastructure is mainly used by INES scientists, the costs of which are covered to some extent by INES.

Undergraduate education

Although undergraduate training at Geology, INES and CEC was not directly part of the mandate of the study, the issue of undergraduate training and how it is implemented is essential in the event of a merger. This is because it influences both the process of how a merger might take place, and if the faculty decides to do so, it becomes an important part of how the merged units will build a common departmental identity.

The Department of Geology offers a Bachelor's programme in Geology and a Master's programme (120 credits) in Geology with three specializations; *Mountain Basic Geology*, *Quaternary Geology* and *Biogeology*. In 2023, 17 different courses (excluding internships and theses) totalling 255 credits will be offered at the department. In addition, there are three distance learning courses totalling 9 credits. The courses offered by the department are listed in Annex 2.

INES offers a bachelor's programme in *Physical Geography and Ecosystem Science* and five master's programmes (120 credits); *Physical Geography and Ecosystem Science*, *GIS and Remote Sensing*, *Geographical Information Science*, *Environmental Changes at Higher Latitudes*, and *Geo-Information Science and Earth Observation for Environmental Modelling and Management*. The latter two are offered in collaboration with several other universities (Nordic Master and Erasmus Mundus Joint Masters Degree

respectively). The Master's programme in *Geographical Information Science* is fully internet-based and distance learning. In 2023, 29 different courses (excluding internships and theses) totalling 355.5 credits will be offered at the department. In addition, there are 19 distance learning courses totalling 227.5 credits. The courses offered by the department are listed in Annex 2.

The CEC offers two bachelor programmes, one in *Environmental Science* and one in *Environmental and Health Protection*. The CEC also offers three Master's programmes (120 credits) in *Environmental and Health Protection*, *Applied Climate Strategy* and *Environmental Science*, the latter of which has six different specialisations: *General Specialisation*, *Chemical Environmental Hazards and Ecotoxicology*, *Soil Conservation*, *Nature Conservation*, *Strategic Environmental Management* and *Water Conservation*. Finally, a Master's programme (60 credits) is offered in *Environmental and Health Protection*. In 2023, 18 different courses (excluding internships and theses) totalling 270 credits will be offered at the CEC. In addition, there is a distance learning course of 7.5 credits. The courses offered by the department are listed in Annex 2.

Postgraduate education

At INES there are currently two postgraduate subjects, *Geobiosphere Science with specialization in Physical geography and ecosystem science* and *Geobiosphere Science with specialization in Geographical information science*, while Geology has two postgraduate subjects, *Geobiosphere Science with specialization in Bedrock geology* and *Geobiosphere Science with specialization in Quaternary geology*. Each department has an Director of postgraduate studies for its two subjects. The CEC conducts postgraduate studies in *Environmental Science* in close collaboration with several departments, not only within but also outside the Faculty of Science. The Deputy Director responsible for postgraduate studies has the role of Director of postgraduate studies.

Together, the three units have 74 active PhD students (as of 1 December 2021), of which 21 are at Geology, 34 at INES and 19 at CEC, according to the following breakdown:

- 9 Geobiosphere Science with spec. in bedrock geology
- 12 Geobiosphere Science with spec. in Quaternary Geology
- 28 Geobiosphere Science with spec. in Physical Geography and Ecosystem Science

6 Geospheric Sciences with spec. in Geographic Information Science
 19 Environmental Science

PhD students in environmental science are located and active in several different departments.

Interdisciplinarity and the relationship with CEC network functions

Interdisciplinary environmental and climate issues cross faculty boundaries and the division often made between environmental research in the natural and social/human sciences is largely artificial. The challenges in environmental and climate science are to understand in depth the complex relationships between the atmosphere, biosphere, geosphere and hydrosphere, and also all the complex relationships between these and our human society, i.e. the anthroposphere. Continuing to separate environmental research in natural science and human science is unlikely to help much in solving the challenges society faces today.

Many universities are now investing heavily in the development of a coherent cross-scientific research on environment, climate and sustainable development. Lund University is well positioned in this increasing competition, where, among other things, CEC has developed into a strong centre during its 12-year history, with recognised strength in environmental and climate-related research and collaboration/communication. This strength has contributed, among other things, to LU's success in attracting more external funding and asserting itself well in international rankings.

Lund University has gathered the interdisciplinary expertise relevant to the investigation primarily at two different centres; alongside the CEC, such expertise is also gathered at LUCSUS, which is part of the Faculty of Social Sciences. Here, too, researchers are employed who work across disciplinary and faculty boundaries, as well as between academia and society. Several researchers at LUCSUS and CEC already collaborate, for example through the LU-Land programme, and the new profile area ClimBioSis has also been formulated in collaboration between LUCSUS, CEC and INES, among others.

There are some differences between LUCSUS and CEC. For example, in its collaborative components, CEC has a greater focus on Swedish (and European) stakeholders, while LUCSUS has a greater focus internationally and in the global south. Research-wise, CEC traditionally has a very strong profile in "global change biology/ecology/geography" (including strong links to INES) with a strong natural science base, while LUCSUS has more focus

on environmental research from a social science perspective. However, there are exceptions within both organisations.

The question of how to organise interdisciplinary science that attempts to link different disciplines to solve societal or scientific problems at the system level is a complex one. Interdisciplinarity claims to develop research by linking different disciplines with different perspectives, thus creating *new* topics or subject linkages, rather than developing old “topics”. At the same time, it must build on the knowledge that exists within these different disciplines. In Lund, this can be illustrated by more interdisciplinary “topics” such as environmental science, climate, natural resources, and sustainability research. The development of such interdisciplinary “topics” often depends on the ability of individuals to work together across disciplinary boundaries, and therefore they may at the same time exclude important perspectives or disciplines that do not want or are not given the opportunity to be involved. One of the many dilemmas of interdisciplinary centres is that “subject affiliation” (or the discipline issue) can be simultaneously enabling and limiting, depending on perspectives and how one views the role of the centre.

During the site visit, it was clear that an important part of the CEC’s strength comes from the close link between the researchers and those involved in research coordination and communication/collaboration. Maintaining a close relationship between these elements in day-to-day work is important. It strengthens both the administrators’ understanding of, and grounding in, the research and it facilitates support to the researchers in both communication/collaboration elements and in keeping the research networks alive. There is currently a well-functioning interaction between the researchers physically present at the CEC and the administrative parts of the CEC.

In order to maintain and ensure the quality of networking functions and interaction/communication, it is important that the administrative and networking functions are linked to a strong research environment at the core of the CEC’s area of activity. This also gives strength to the research environment.

Opportunities and risks of a merger

Major organisational changes always place a strain on the activities concerned. Based on the experience of the review team, there are some basic factors or conditions that must always be met for such a change, in this case a merger, to be successful. The following basic factors or preconditions are considered

important to bear in mind when identifying and formulating opportunities and risks based on the specific circumstances.

Goals and vision - It is important to have clear goals and a clear vision for the new entity, which are recognised by a clear majority of staff. What are we aiming to achieve and why? Ideally, these goals can be broken down and made clear to the different activities and categories of staff, as a set of questions:

- What are the goals and visions for research and its conditions?
- What are the objectives of education at all levels?
- How would the economic conditions be improved and what are the economic objectives?
- How does the change improve administration?
- How well do the different objectives coincide, or are some objectives or areas more important than others?
- Finally, what is the overall vision for the new organisation as a whole?

Integration – A basic prerequisite for a merger to yield real benefits, in both administrative and scientific terms, is that the new entity becomes an integrated department with new constellations. A merger that merely brings existing activities under a new organisational umbrella has little chance of leading to real development and renewal of both research and education.

Localisation – Real integration is almost impossible to achieve unless all staff in the new organisation can be co-located in the same and appropriate premises.

Key persons – At an early stage, key persons need to be identified who can (and are committed to) drive the change process forward in a positive spirit. Such persons should have both leadership qualities and the trust of employees. In the absence of these persons, there is a risk that change will only lead to additional work and not to the strategic lift that would otherwise be possible.

Resources – A change always involves significant effort for all employees at the initial stage. Even well justified reorganisations and mergers are often met with some resistance stemming from the feeling that one knows what one has but not what one gets. Resources must therefore be made available to deal with the inevitable extra work involved in the change phase and to motivate and create good conditions for the new organisation.

Opportunities

There are several obvious opportunities offered by the proposed merger, regarding both administration, research and education. The Faculty has already stated in the mission statement that the RQ20 evaluation considered that there are opportunities for deeper interdisciplinary collaboration in environmental science, geology, physical geography and ecosystem science. RQ20 also pointed to the potential for deeper collaboration on interdisciplinary sustainability issues with LUCSUS. The review team shares this view; if the merger is successful, there is great potential for increased research collaboration in a joint department and, barring proper organizational form, expanded collaboration with LUCSUS.

Research

In today's research environment, it is clear that a combination of subject depth and breadth is a strength of the University's activities. The constituent units of the proposed CIG constellation can combine strong intra-disciplinary basic research and cross-system and inter-disciplinary research and collaboration, which can give a new merged department considerable strategic strength. Such a department is well suited to attract both interdisciplinary and intra-disciplinary researchers, faculty and students. A unifying interest is the time scale – past-present-future as contextualized within geology-physical geography-environmental science. In this area there is, for example, great potential to contribute research demonstrating the importance of bedrock geology for a green transition, where issues of land use and access to innovation-critical minerals and metals, as well as interdisciplinary issues of sustainability, natural resource management and related societal challenges are central. This could lead to a strengthening of the “brand” of a new department, in a way that separate units would be less suited to achieve.

A significant part of the research coordinated by the CEC is linked to the biodiversity research currently based at the Department of Biology. Moving these activities into a new CIG department would bring a very large part of the natural science base of CEC activities under one roof. The CEC and its network functions would then be in a much larger, integrated research environment than at present.

From the outside perspective of the investigation team, we have noted that there are also other groupings outside the current Geology, INES, CEC and Biology that are clearly linked to the subject areas or research areas that a new CIG department would cover. It is possible that research could be developed

even further if these groupings were integrated into the CIG department. One such grouping is the aerosol group at LTH, whose research is very close to the climate-related research carried out by several groups within INES and CEC. The integration of these research groups could also bring about a rapprochement and a clearer coordination between the ICOS and ACTRIS infrastructures. The investigation team is aware that the aerosol research and ACTRIS fall under LTH, and that the Faculty of Science thus does not have the mandate to decide on their location. Nevertheless, we would like to highlight what we see as clear opportunities for Lund University in connection with the establishment of a new department. Within LTH there are also some geological activities at the Department of Biomedical Engineering, with which Geology already has cooperation on undergraduate education. In this case, too, Lund University could potentially benefit from coordinating these activities with the research and education conducted in a new CIG department.

Infrastructure

Lund University hosts the Swedish nodes of both ICOS and ACTRIS, two national infrastructures of crucial importance for climate research not only in Sweden but also internationally through the large European networks of which both infrastructures are part. ICOS is currently under CEC and the associated Carbon Portal is under INES, while ACTRIS is organisationally located at LTH. It seems obvious to the investigation team that ICOS would benefit greatly from administration and research being coordinated within the same department, and further benefits would arise if ACTRIS was also under the same department. On the one hand, the administration and operation of the infrastructures could probably be streamlined, and on the other hand, the coordination between ICOS and ACTRIS could be developed, which could have positive effects also at the local and national level. This issue is also topical within VR (the Swedish Research Council) where there are advanced plans to merge these national infrastructures with SITES (Swedish Infrastructure for Ecosystem Science).

The national infrastructure Riksrigen is linked to the Division of Engineering Geology within the Department of Biomedical Engineering at LTH. If Lund University would be able to bring together geological expertise in a common CIG department, our perspective from the outside is that it would be natural for Riksrigen to be based there as well.

For other small and medium-sized infrastructures, there are possible advantages to merging, it would create opportunities for larger groupings of research engineers and less sensitivity to variations in staff resources.

Education

Although undergraduate education is outside the scope of the study, it is impossible to discuss a merger without considering education from both a teacher and researcher recruitment perspective. Coordinating undergraduate education in the subject areas of a new department could lead to better use of existing teachers and researchers. It can also help to develop both courses and learning environments to attract more students. Undergraduate education could likely be better coordinated, with courses common to the department's subjects at least in the first semesters. Even if we only looked at the course offerings without going into the schedules in detail, it seems highly likely that many current environmental and geoscience courses contain similar elements. A merger could help to develop new, attractive and joint master's programmes and lead to the strengthening of postgraduate education and research in the department's subjects. It should also be easier to find teachers to teach different courses and save on teacher administration.

A larger department would mean a larger and broader academic environment for the PhD students and a larger PhD student community. The combination of more doctoral students and more faculty could create critical mass for new doctoral courses and other activities that enrich doctoral education.

Administration

Coordination of technical and administrative staff, such as financial and human resources management, teaching administration, information/communication and IT, can make the work at a larger department more efficient and, above all, less vulnerable. Tasks that are infrequent in a small organisation would be more common, allowing staff to cover for each other. The administrative demands on universities seem to be constantly increasing and becoming more complex, which means that small organisations will find it increasingly difficult to meet these demands. In a larger organisation, there are better opportunities for specialisation in administrative functions. The on-site visit revealed, among other things, that the CEC's basic administration sees advantages in these respects in being part of a larger organisation.

In particular, the CEC has well-developed research coordination and communication functions that could feed into the research and administrative functions of the new department. Even if research coordinators and communicators associated with the CEC's transdisciplinary development mission and the specific networking components were to work on separate tasks within the Centre, co-location would still be likely to lead to a greater natural exchange of information and added value for both research groups and administration.

Not least, in a smaller department it can be a challenge to find suitable faculty willing to take on administrative tasks such as head of department or director of studies. This will be facilitated if a merger into a large department is implemented.

Profiling and visibility

A well-functioning merged department can also contribute to increased national and international visibility, which can attract both students and researchers. Calls for faculty, research, and doctoral positions can be coordinated and advertised jointly under one department, which increases attractiveness as it gives the overall impression of a strong academic environment.

With LU moving part of its operations to Brunnshög, a merged department will provide a unique opportunity to create a strong and cohesive research environment in geosciences and environmental sciences, centrally located in the city centre of Lund. This provides opportunities to bring together these research areas so that they get a common voice at the university, which can strengthen the influence on issues central to the university. A merged department can also contribute to increased visibility nationally and internationally. By developing an attractive profile for the specialisation, the new department will have a stronger visibility.

Economy

A merger would create a department with significantly larger financial resources and thus much better able to cope with fluctuations in the allocation of funds. This is an important consideration as LU, like other universities in the country, is apparently entering a period of increasing uncertainty around rising rental costs, government reprioritisation, increasing administrative burdens and regulation, and a likely declining stock market (which directly affects the major private research funders).

In recent years, the research funding landscape has moved towards ever larger grants to ever larger research constellations. A department with a larger budget and strong and broad research activities is in a better position both to attract large external research grants and to manage the substantial co-funding that is usually required to accommodate such grants. This is particularly true for infrastructure grants and grants from European research funding agencies. A larger budget also provides better opportunities to work strategically on recruitment.

Premises

Preliminary investigations by the Faculty have indicated that there are possibilities for co-location of current units in existing premises in Geocentrum I and II, which would overall reduce the rental costs of a new CIG department and at the same time solve the acute space problems faced by the CEC. In addition, more space is available in Geocentrum I in the longer term (2026). Thus, there should be possibilities to integrate staff and activities from other entities into the new department if it is found desirable. It would also be possible to raise the visibility and profile of the CEC as a centre while being physically integrated into a broad academic environment where the bulk of the CEC's science activities are carried out.

Risks

The disadvantages and risks of merging departments have been discussed with the various departments/units to be included in the new department, with other departments concerned, and with the faculty. Some of these can be described as uncertainties that many, but by no means all, experience in reorganisation. These will be discussed briefly below. Other risks, however, are directly related to the academic issues of the relationship between disciplines and interdisciplinarity touched upon earlier. These risks are important to separate from the perceived risks that a well-executed merging process can avoid. The risks below are those that we wish to draw specific attention to.

Identity and continuity

A key challenge is to succeed in forming a common identity of existing activities that already have strong identities. During the site visit, it was clear that many at both INES and Geology are concerned about the survival of their established disciplines in the event of a merger. For the overall competence of a comprehensive university, this is of course a key issue that needs to be considered. At the same time, it is natural that many university subjects take

shape, develop and then merge into new subjects or dissolve. While broad subjects such as geology, chemistry, physics, and biology will always remain, there is a dynamic of sub-disciplines that needs to be nurtured. There is a risk that the “subject” is seen as forever defined and therefore conservative, as indirectly expressed by some during our discussions. Such a view may become an obstacle not only to merging but also in general to the development or “evolution” that is always necessary in academic activities.

There is also a risk that smaller or peripheral areas of research are disadvantaged or disappear altogether – something that may in itself be part of the university’s renewal but is often perceived as negative by those directly involved. However, a smaller research area can be strong, and it is of course particularly important that it is not overshadowed and disappear in a merger. At Geology, for example, there is research that may be perceived as intradisciplinary and narrow from an interdisciplinary environmental research perspective, but which is at the same time unique and strong and should be taken into account in a merger. At CEC there are researchers with more social scientific backgrounds and there may be a concern that this kind of activities will be marginalised in a large natural science department.

As mentioned above, an indirect effect of the CEC move may be that at least part of biodiversity research risks disappearing from the Department of Biology. Alternatively, some of these CEC-affiliated researchers may wish to remain in the Biology Department because their research is closer to biology than to INES and Geology. This could have negative consequences for, among others, land use research at CEC. It is unclear how big these risks are, but they need to be elucidated by the faculty, i.e. before a decision is made whether or not to merge.

Interdisciplinarity and network functions

CEC has been successful in helping to develop cross-disciplinary and inter-departmental constellations, e.g. through the BECC and MERGE SFOs and the recently designated ClimBioSis profile area. These successes were initially based on the CEC’s ability to link a number of departments around common cross-disciplinary problem areas, on its ability to initiate and support interdisciplinary initiatives, and thus researchers and activities in departments other than just those covered by the survey. Therefore, placing interdisciplinarity under a subject-defined department may risk its legitimacy; from crossing departments, it becomes part of a department and thus subject-defined in a way that does not favour the original idea of linking different

subjects in different departments. It has been expressed that the networking functions of the CEC may risk “drowning” in a large department if they become fully subsumed into the department and subordinated to its economy.

Today, a large amount of research funding is on-lent through CEC to other departments and universities. Much of this on-lending takes place within the SFO programmes BECC and MERGE. It is important that this on-lending continues in order to strengthen collaborations between all researchers in the respective fields.

The link between education and research

The site visit indicated that there are research activities and areas that are not matched by the education programmes offered and that, at least in some places, there appears to be a clear disconnect between the teaching needs of education and the interests of research staff. While there is considerable scope for developing courses and curricula, there is a risk that teaching burdens will be distributed unevenly and the quality of education will suffer if the perceived dissonance between research and the needs for teaching cannot be dealt with.

Protectionism

A particularly important question is how to allocate resources, compared to the current situation. There will be a risk of protectionism, as economic allocation is what drives the business. If entities enter into a merger with widely differing financial starting points, there is a significant risk that groupings may feel disadvantaged. This risk is equally present whether the differences are actual or merely perceived. Expectations of a better economy with new services may also not be met to the extent hoped. The importance of internal communication on these issues, both before and during a merger, cannot be over-emphasised.

Conclusions

A successful merger of departments and, in this case, including a successful centre, requires that there is a clear idea behind the change. This can be either strategic, for the university or for the constituent departments, or organisational. In the latter case, merging is thought to facilitate or improve the governance of the university or a faculty. In both cases, there are both research and teaching aspects to consider. The needs of the research community are not always the most relevant to the needs of the teaching community for timeliness and renewal, and vice versa.

Hence, it is important with a clear vision and clear objectives from the faculty's side in the further work towards a merger. What are we aiming to achieve? This should be clearly communicated to staff. The Faculty should also work towards co-location as soon as possible to facilitate collaboration within the new department. As a merger would involve significant additional work for staff at the initial stage, resources need to be allocated for smooth implementation.

It is essential that employees are allowed to own the process of merging. A number of working groups need to be set up with different focuses and given a certain amount of time to develop the evidence base. Time is an important factor here, staff need time to work through a number of key issues, but at the same time the merging process should not be too drawn out, as there is a risk of creating more problems than solutions. It is also necessary to define a clear organisation for the new department and a structure for management and for the various working groups. This organisation should be discussed by and agreed with the staff.

Proposal

Based on the descriptions above, the investigation finds that there is great potential in merging Geology, INES and CEC into one department, in common premises, in terms of research, infrastructure, teaching and administration, without compromising the networking interdisciplinarity. This new department can be very strong in research related to geosciences and environmental sciences, become a hub for this research within Lund University, and has the potential to become influential in this field both in Sweden and internationally. Similarly, teaching at different levels could be strengthened by the increased cooperation that a joint department would bring. It is also highly likely that administration would be significantly strengthened by the increased redundancy of a larger organisation. However, the question of whether and, if so, how interdisciplinarity at the CEC might be strengthened by the proposed merger is complex. It is being addressed in part by a parallel study but will require further discussion.

As shown above, there are both opportunities and risks with a merger and therefore we propose that the faculty decides to start a preparatory work with the aim of forming a joint department. Below we describe what such a joint department might look like.

Organisation

Overall, we propose a department where the previous departmental division is broken up and replaced by new research groupings. The network activities belong to the department but have their own budget for their activities. In order to maintain its strong interdisciplinary activities as well as cooperation within Lund University and with the rest of society, we propose that the network retains the name *Centre for Environmental and Climate Science* (CEC). We leave the detailed organisation of the network to its specific investigation. Otherwise, the department will be organised according to the faculty's rules of procedure, i.e. led by a perfect and a relevantly staffed board, etc. We consider it essential that the latter includes teaching staff with a broad grounding in the various subject areas.

In order to further demonstrate transparent leadership, it is important to form a preparatory body with representatives of the different research groups (see below for details on these) and the network activities. This preparatory body, the *Strategic Research Council*, should focus on strategies in terms of profiling, including the targeting of new research positions, etc. This group may also be able to prepare the allocation of PhD students between research groupings, if there are resources for faculty funding of PhD students. For the day-to-day operations, where in addition to research issues, also undergraduate education and technical/administrative issues are dealt with, we recommend a small management group led by the Head of Department with the participation of the administrative head, the responsible economist and the directors of studies. The overall structure is illustrated in Figure 1.

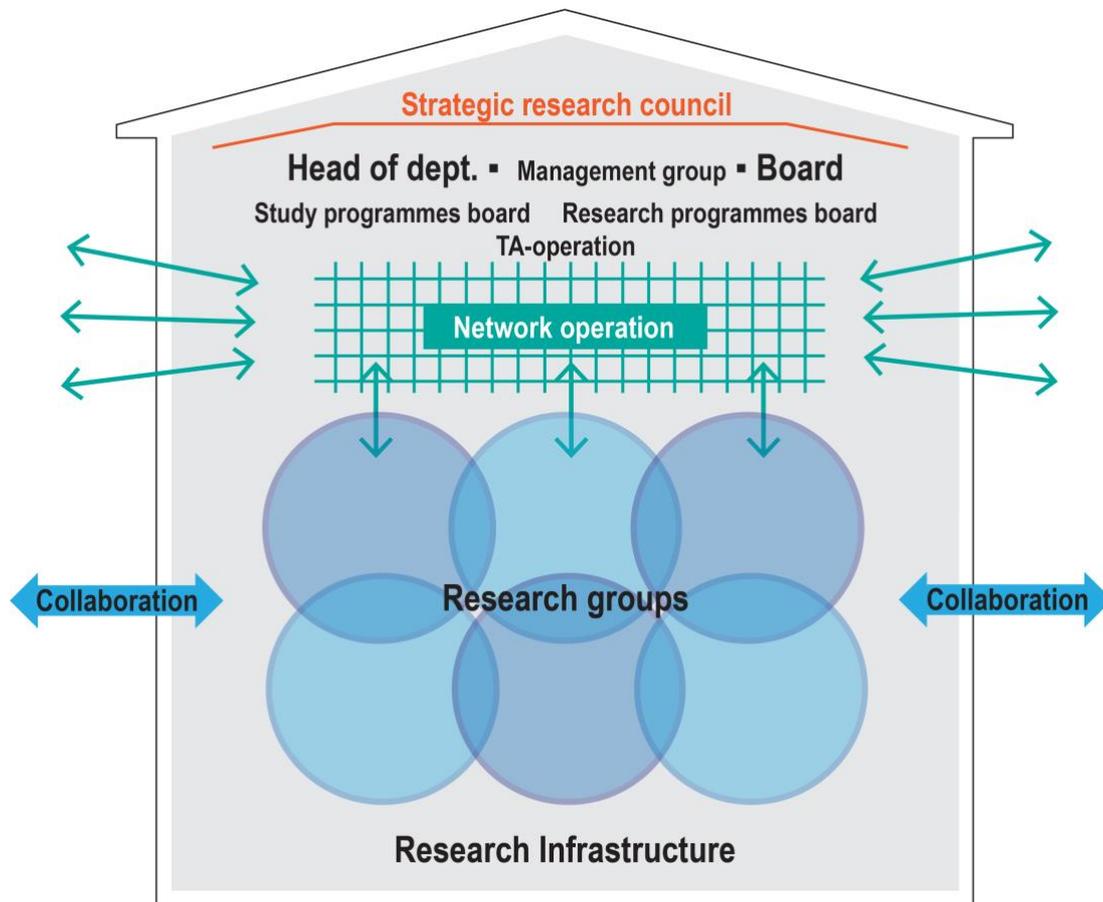


Figure 1. Schematic illustration of the organisation of the new department.

The focus of the different research groups is a question that has to be prepared by the staff and will be a central part of the merger process. Research groups should cut across the current structure, and could be both methodological groupings (e.g. numerical modelling, geographic information systems and machine learning), and subject-specific orientations (e.g. climate change in space and time, earth evolution and natural resource flows in the “human age”, landscape and biodiversity management for societal development, co-creation of knowledge on natural resources). The groupings should reflect both the breadth and depth of science in the department and all staff must feel a sense of belonging to a group. The number of research groupings could be between 5 and 8, each with a representative on the Strategic Research Council.

The research groupings should be quite loose and welcoming in their structure, with researchers able to change groups if they wish. There should be no formal leadership, rather they should operate in a collegial spirit, but the representative on the Research Council should feel a responsibility to manage and keep the group together. Apart from external grants, which are normally handled by the applicant, the review team believes that research groups should not have financial autonomy or control over recruitment. Instead, this should

be handled at the departmental level. A few distinct postgraduate subjects could be established at the new department to specifically profile different research areas. These could be classical research subjects; such as geology, physical geography and environmental science.

An absolutely crucial issue for the successful consolidation of a new department is a head of department and a board that has the confidence of the staff and is responsive but also clear in its decisions. It is also of value that such a person is well acquainted with the organisation and thus is aware of many essential aspects of research, teaching, administration as well as cooperation partners. Before a formal decision is made to merge, the faculty should ensure that suitable people are available to fill management positions.

Administrative staff should be coordinated to optimise skills and redundancy. As Geology and INES already have a common office, this should be the basis for such planning. Similarly, the technical staff should be formed into some kind of working group to exchange experience and skills. However, as this group of staff is often very much tied to specific infrastructure, co-location is not appropriate.

Research coordinators and research information officers should be co-located and close to the relevant research activities. It is important that they are respected for the depth of expertise they possess in their fields, and the often broad expertise they have in understanding research.

Strategy

The overall strategy of a new department must be to strengthen both research and education through broad cooperation. The various research groups will have a central role to play here, together with other relevant preparatory bodies, particularly in the field of teaching.

Research

It is important that the new department's researchers and teachers affirm different subject areas and are devoted to developing them, i.e. that the department avoids internal competition for the university's limited resources, but rather increases its competitiveness for national and European research grants and students (including master's and doctoral students).

Infrastructure

A joint department is responsible for a comprehensive and high-quality research infrastructure, ranging from the national infrastructure ICOS to local

infrastructures such as the ICP-MS lab and the dendrochronology lab, etc. In a slightly longer perspective, it would make sense to transfer the ACTRIS activities from LTH to the new department in order to optimise both the research and technical aspects of the field stations together with ICOS. We also believe that the Riksrigger should be located at the new department where extensive geological research is conducted.

The first 5 years of ICOS ERIC were evaluated in 2020 and received very positive reviews in terms of management and data management. The user-friendly data access and service of the Carbon Portal was particularly noted. However, there was a call for increased collaboration, on many levels, and its importance for research. The exploitation of ICOS data, both ground and atmospheric, could be enhanced by increased internal research collaboration, possibly also through strategic recruitment.

Positions

As described above and in the RQ20 evaluation, much successful research is currently being conducted in the three units, but nothing is so good that it cannot be improved. Lund University, including CEC and INES, funds large parts of the ICOS infrastructure and conducts a lot of research linked to the collected data. This is mainly modelling, but to a lesser extent process studies. A special investment in a position for a prominent researcher in the latter area would strengthen all ICOS-relevant research at LU.

A new merged department would benefit from new strategic teaching positions that aim to link research in subject-specific and strong areas to the broader more interdisciplinary research of the new department. These appointments should also include a review of skills in relation to the range of courses on offer, particularly all those courses currently run by the CEC but taught by external faculty. Examples of possible areas for announcements of teaching positions that in this way both link research, make use of infrastructure, can contribute to education, and aim to create new innovative directions of education are:

- Rock geology with a particular focus on sustainable extraction of natural resources necessary for green transition.
- Process studies, using the infrastructure and linked to the department's strong modelling of global changes in the geosphere and biosphere.
- Synthesizing geospatial big data for sustainability analyses.

The link to Biology

In the context of a merger, a review should be made regarding which researchers in the Department of Biology, working on issues relevant to the environment and sustainability, that might consider moving to the new department. The Department of Biology has several research groups that are relevant. In particular, we see that “green” biodiversity research, i.e. the Biodiversity and Conservation Science research group, which is already strong at CEC, would be valuable to a new department. Other research groups in biology that partly involve biodiversity or land use, such as microbial biogeochemistry, the soil group and microbiological ecology, are also interesting for a CIG department, but rather as collaborators. Several collaborators from these groups are already part of the BECC or CEC. This highlights the importance of maintaining and allowing to develop the networking functions of the CEC towards other departments in the envisaged new department. With regard to the Biology Department, it is difficult to see that most of the other research groups would benefit from being part of the envisaged new department, although individual researchers may benefit greatly from its networking activities.

The road to a new department

We recommend that the faculty makes a policy decision on a departmental merger and then identifies key people to work on key issues.

As stated above, it is extremely important that employees are allowed to own the merger process. The greatest risk is if employees feel they are being forced into something they cannot influence. For this reason, we believe that a merger must be preceded by a process in which working groups are tasked with preparing various relevant issues. These include:

- profiling, the name of the new department
- focus of the research groups
- the organisation of the infrastructure
- review the postgraduate curricula (“subjects”)
- development of basic education (1st and 2nd cycle)
- possibly a few more according to employees’ wishes

The work on the various groups must be allowed to take time, but must not take too long, suggesting a maximum of one year.

One extremely important issue that must be given special attention is the co-location of all activities and how this is to be organised in detail. This links in with many of the issues above, such as infrastructure and the focus of the research groups. Also, the issue of coffee/lunch rooms is extremely important. A working group on these premises issues should be initiated as soon as possible as it is not directly linked to a merger but is an important step for future cooperation regardless of the form of organisation.

Acknowledgement

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Annex 1 - Basic facts about the units

INES

Staff development over the last five years

Personnel category	2018	2019	2020	2021	2022*
Professor	9	9	9	9	8
Lecturer	13	13	13	12	12
Career development positions	6	6	5	6	6
Assistant Professor	3	3	3	4	4
Other teaching and research staff	23	28	29	31	33
PhD student	19	22	25	26	25
Administrative staff	8	7	8	8	9
Technical staff	6	7	7	7	7

* Applies to the first three months of the year

Financial summary (MSEK) for the last five years

INES	2017	2018	2019	2020	2021
Turnover (total costs)	93	97	107	106	111
Research	75	78	89	88	92
<i>of which external funds</i>	38	42	53	52	55
<i>Agency grants</i>	36	34	34	34	35
<i>Commissions</i>	0	2	2	2	2
Education	18	18	18	18	18
<i>of which agency grants</i>	18	18	18	18	18
<i>Other</i>		1	0		
Agency capital	37	44	37	35	40
Unspent agency grants	43	44	46	50	58

Geology

Staff development over the last five years

Personnel category	2018	2019	2020	2021	2022*
Professor	9	9	9	9	9
Lecturer	8	8	9	9	9
Career development positions	2	4	6	4	2
Assistant Professor	1	1	1	1	1
Other teaching and research staff	12	13	13	17	19
PhD student	13	17	19	17	20
Administrative staff	10	10	9	8	10
Technical staff	3	3	3	3	3

* Applies to the first three months of the year

Financial summary (MSEK) for the last five years

Geology	2017	2018	2019	2020	2021
Turnover (total costs)	72	69	77	81	80
Research	60	56	66	69	67
<i>of which external funds</i>	<i>34</i>	<i>28</i>	<i>32</i>	<i>38</i>	<i>34</i>
<i>Agency grants</i>	<i>26</i>	<i>28</i>	<i>30</i>	<i>31</i>	<i>33</i>
<i>Commissions</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
Education	12	13	14	12	12
<i>of which agency grants</i>	<i>12</i>	<i>13</i>	<i>14</i>	<i>12</i>	<i>11</i>
<i>Other</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0</i>
Agency capital	7	12	16	19	15
Unspent agency grants	21	29	40	29	30

CEC

Staff development over the last five years

Personnel category	2018	2019	2020	2021	2022*
Professor	2	2	2	3	3
Lecturer	2	2	2	2	2
Career development positions	8	13	14	11	8
Assistant Professor	1	1	1	1	1
Other teaching and research staff	12	14	19	22	22
PhD student	8	6	11	11	10
Administrative staff	12	15	18	18	18
Technical staff	1		1	1	1

* Applies to the first three months of the year

Financial summary (MSEK) for the last five years

CEC	2017	2018	2019	2020	2021
Turnover	65	70	75	85	92
Research	58	62	66	74	79
<i>of which external funds</i>	26	28	29	36	41
<i>Agency grants</i>	31	33	36	37	38
<i>Commissions</i>	1	2	1	1	1
Education	7	8	9	11	12
<i>of which agency grants</i>	7	8	9	11	12
<i>Other</i>				1	0
Agency capital	47	24	25	25	28
Unspent agency grants	30	28	46	56	59

Annex 2 - Courses offered by the units

INES, Courses offered 2023

Course code	Course name	HP
Basic level		
NGEA01	Physical Geography, Introduction to the Global Environment	15
NGEA03	Remote sensing for Landscape Studies	15
NGEA04	Ecosystems Analysis	15
NGEA05	Physical Geography, Remote Sensing and GIS with Focus on the Environment	15
NGEA07	Theory and Methods of Physical Geography	15
NGEA09	Land Surface Processes and Landscape Dynamics	15
NGEA11*	Geographical Information Systems – Basic Course	15
NGEA12*	Geographical Information Systems – Advanced Course	15
NGEA21	The Climate System	15
NGEA22	Hydrology	15
NGEA26**	Climate Now	5
NGEA51	Internship	15
NGEK01	Bachelor's Degree Project	15
Advanced level		
NGEA50*	Surveying	9
NGEN01	Climate Change and its Impacts on the Environment	15
NGEN02	Ecosystem Modeling	15
NGEN14	Greenhouse Gases and Biogeochemical Cycles	15
NGEN17	Global Ecosystem Dynamics	15
NGEN18**	Statistical Tools for Climate and Atmospheric Science	5
NGEN19**	Climate Change in the Arctic	5
NGEN20	Programming for Applications in GIS and Remote Sensing	15
NGEN21	Applied GIS	15
NGEN09	Remote Sensing – Digital Methods	7,5
NGEN22*	Geographical Databases	7,5
NGEN23*	Spatial Analysis	7,5
NGEN24	Satellite Remote Sensing	15
NGEN25*	Algorithms and Data Structures in GIS	7,5
NGEN26*	Web GIS	7,5
NGEN27	Geospatial Artificial Intelligence	7,5
NGEN28	Collection and Analysis of Geospatial 3D Data	7,5
EXTF80	Geographic Information Technology	12
EXTG75	Geographic information systems for landscape studies	7,5
NGEM01	Master's Degree Project	30

* Co-located with LTH

**ECHL Nordic Master Environmental changes at higher latitudes

INES, Courses offered 2023 within the distance master's programme

Course code	Course name	HP
<i>Basic level</i>		
GISA21	Geographical Information Systems - Introduction	15,0
GISA22	Geogr. Information Systems - Advanced Course	15,0
<i>Advanced level</i>		
GISN04	Open Source GIS	7,5
GISN06	Geographical Databases	7,5
GISN07	GIS and Algorithms	7,5
GISN08	Digital Remote Sensing and GIS	7,5
GISN09	Internet GIS	7,5
GISN11	GIS and Biodiversity	7,5
GISN14	Geogr. Information Systems and Physical Planning	7,5
GISN15	Research Methodology	7,5
GISN31	GIS and Statistical Analysis	5,0
GISN32	GIS and Climate Change	7,5
GISN33	GIS in Tourism and Recreation	7,5
GISN34	Python Programming in GIS	5,0
GISN35	Spatial Data Infrastructure	5,0
GISN36	GIS and Distributed Hydrological Modelling	7,5
GISN37	Research Methodology	5,0
GISM01	GIS Master's Degree Project	30,0
<i>Lifelong learning</i>		
GISA23	Introduction to GIS 1	7,5
GISA24	Introduction to GIS 2	7,5

Geology, Courses offered 2023

Course code	Course name	HP
<i>Basic level</i>		
GEOA02	Planet Earth – An Introduction	15
GEOA82	Earth, Water and the Environment	15
GEOB21	Evolution of Life and Earth's Climate	15
GEOB32	Mineralogy and Petrology	15
GEOB33	Sedimentology and Structural Geology,	15
GEOB24	From the Ice Age to the Present and Swedish Regional Geology	15
GEOB25	Geology in Society	15
GEOC08	Underground Pollution	15
GEOC91	Geology: Practical Training	15
GEOL02	Geology: Bachelor's Degree Project	15
<i>Advanced level</i>		
GEOM10	Sedimentary Geology and Basin Analysis	15
GEOM11	Magmatic Petrology, Geochemistry and Geochronology	15
GEOM08	Metamorphic Petrology and Structural Geology	15
GEOM09	Evolution of the Biosphere, Palaeoecology and Palaeontology	15
GEON05	Glacial Sedimentology – Processes, Sediments and Landform Systems	15
GEON06	Palaeoecological Methods and Environmental Analysis	15
GEON08	Marine Geology and Environmental Change	15
GEON09	Global Environmental Change from a Geological Perspective	15
GEOP06	Hydrogeology	15
GEOR01*	Master Degree Project	30
GEOR02	Master Degree Project	45
<i>Lifelong learning</i>		
MNXG01	Planet Earth as a System - Temporal Perspectives and Sustainable Development	3
MNXG02	Geology of Sweden	3
MNXG03	Scientific Dating in Archaeology and Heritage Management	3

* Go irregularly

** Given every year

CEC, Courses offered 2023

Course code	Course name	HP
<i>Basic level</i>		
MVEA10	Environmental Science: Basic Course	15
MVEC18*	Law in Environmental Studies	15
MVEC10	Risk Assessment in Environment and Public Health	15
MVEC20**	Industrial Environmental Economics	15
MVEB16	Environmental policy and management	15
MVEF01	Environmental Science: Applied Work	15
MVEK12	Environmental Science: Degree Project	15
MVEK13	Degree Project with Specialisation in Environmental Health	15
<i>Advanced level</i>		
MVEN13	Environmental Science: Analysis and Methodology	15
MVES13	A Circular and Biobased Society	15
MVES04	Environmental Assessment	15
MVEN22	Environmental Health: Methods and Professional Training	15
MVEN21	Environmental Health – Food Safety	15
MVEN24	Applied Environmental Science	15
MVEN15	Climate Change, Science and Society	15
MVEN16	Climate policy, Governance, and Communication	15
MVEN27	Planning with Climate in Focus	15
MVEN18	Methods for Climate Risk Management	15
MVES02	Governance and instruments in business	15
MVET10	Environmental Protection	15
MVES01	Environmental Management, Sustainability and Business Value Creation	15
MVEP10	Environmental Science: Applied Work	15
MVEM02	Environmental Science: Degree Project, Master 1 year	15
MVEM03	Environmental health: Degree Project, Master 1 year	15
MVEM14	Thesis for Master's degree in Environmental Science	30
MVEM15	Thesis for Master's degree in Environment and Health Protection	30
MVEM31	Thesis for Master's Degree in Applied Climate Strategy	30
<i>Lifelong learning</i>		
MNXD11***	Sustainable development for the earth, life and the environment	7,5

* Given by EHL Commercial Law

** Given by the Environment Institute

*** Given in collaboration with Biology, Geology, INES

Annex 3 - Review team

Leif Anderson, University of Gothenburg. Professor Emeritus at the Department of Marine Sciences (Chair).

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