

Research Review

Earth Sciences

2008-2013

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Report on the evaluation of research in Earth Sciences at Utrecht University and VU University Amsterdam

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Foreword by the committee chair

This review has examined the quality, productivity, impact and viability of Earth Sciences research over the past six years (2008-2013), at three institutes and in seven programmes at the VU University Amsterdam and Utrecht University.

The Review Committee consisted of four professors from renowned universities in Europe and the United States of America, and a chairman from the Netherlands. We have enjoyed working together, drawing on our different backgrounds and research traditions to examine the strengths and weaknesses of the Dutch institutions we visited. It has been an intellectually stimulating experience and as chair I greatly appreciate the commitment and high quality contributions of my fellow committee members.

We would like to thank the research leaders, the academic staff and the PhD candidates at both universities. They compiled detailed quantitative and narrative documentation in their self-evaluation reports, and we recognise how time-consuming it is to create such reports. On the site visits, we found our meetings with staff engaging, lively, revealing and thought-provoking, with much to discuss and explore.

Finally, we thank Floor Meijer, the primary secretary to the review, and her colleague Kees-Jan van Klaveren. Floor and Kees-Jan helped us to overcome the initial apprehension which is common in newly formed teams that have to perform a complex task in a short period of time and provided guidance throughout the process, from the very beginning to the completion of the report.

The goals of the review are to contribute to the improvement of the quality of research and to provide accountability for the use of (public) money for the research organisation's board, funding bodies, the government and the European Union, as well as for industry and society at large. We hope that our comments on each institute and programme will be useful, in our role both as quality reviewers and as 'critical colleagues', to aid further development and ensure a bright future for Earth Sciences research in the Netherlands.

Hessel Speelman
Chair of the Committee

1. The review committee and the review procedures

Scope of the assessment

The Committee was asked to perform an assessment of the research in Earth Sciences at Utrecht University (UU) and VU University Amsterdam (VU). This assessment covers the research conducted in the period 2008-2013.

In accordance with the Standard Evaluation Protocol 2009-2015 for Research Assessment in the Netherlands (SEP), the Committee's tasks were to assess the quality of the institutes and the research programmes on the basis of the information provided by the institutes and interviews with the management and the research leaders, and to advise on how it might be improved.

Composition of the Committee

The composition of the Public Administration Committee was as follows:

- Dr. H. (Hessel) Speelman (chair) is vice-chairman of the Waddenacademie KNAW, the Netherlands.
- Prof. G. (Guust) Nolet is George J. Magee Professor of Geophysics, emeritus, at Princeton University and emeritus professor at the Université de Nice/Sophia Antipolis.
- Prof. G. (Gerald) Haug is Professor of Climate Geology at ETH Zurich, Switzerland.
- Prof. N. (Niels) Hovius is Professor of Earth Surface Dynamics at GFZ German Research Centre for Geosciences and the University of Potsdam, Germany.
- Prof. E. (Eric) F. Wood is Susan Dod Brown Professor of Civil and Environmental Engineering at Princeton University, USA.

Short curricula vitae of the Committee members are included in Appendix 2.

Dr. F. (Floor) Meijer of QANU (Quality Assurance Netherlands Universities) was appointed project manager and secretary to the Committee. Drs. K.J. (Kees-Jan) van Klaveren of QANU attended the site visit as second secretary to the Committee.

Independence

All members of the Committee signed a statement of independence, affirming that they would assess the quality of the institutes and research programmes in an unbiased and independent way. Any existing personal or professional relationships between Committee members and the programme under review were reported and discussed in the Committee meeting. The Committee concluded that there were no relations or dependencies that could jeopardise the impartiality of its judgement and that there was no specific risk in terms of bias or undue influence.

Data provided to the Committee

The Committee has received detailed documentation consisting of the following parts:

- Self-evaluation reports of the units under review, including all the information required by the Standard Evaluation Protocol (SEP), with appendices.
- Copies of the key publications per research programme.

Procedures followed by the Committee

The Committee proceeded according to the SEP 2009-2015. Each institute and programme was assigned to two reviewers, who independently formulated a preliminary assessment. The first reviewer was chosen on the basis of his expertise in the domain of the programme; the second reviewer was chosen to provide a more general, complementary perspective.

Before conducting interviews with representatives of the institutes and programmes under assessment, the Committee was briefed by QANU about research assessment according to SEP. It also agreed upon procedural matters and aspects of the assessment. For each university it discussed the self-evaluation report, key publications and the preliminary findings for all research programmes and institutes before commencing the interviews.

The interviews took place during site visits to VU University Amsterdam (January 21st, 2015) and Utrecht University (January 22nd-23rd, 2015). The schedule for the site visits is included in Appendix 3. The site visits consisted of interviews with (1) the management of the research institute, (2) representatives of the research programmes and (3) a selection of PhD candidates. The first reviewers led the interviews, and then the second reviewers and the other Committee members were given the opportunity to ask questions. After each interview the Committee took some time to prepare a tentative assessment.

At the end of its meeting in Utrecht, the Committee discussed the scores of all 3 institutes and 7 programmes. The final assessments are based on the documentation provided by the institutes, the key publications, and the interviews with the management and the leaders of the programmes. The texts for the Committee report were finalised through email exchanges. The first assessor was responsible for writing the draft assessment and for sending it to the second assessor for amendment and/or approval. After both assessors had approved it, the assessment was inserted into the report. After receiving all assessments, the secretary compiled the report and returned it to the Committee for comments, revision and a final approval. The approved version of the report was presented to the faculties for factual corrections and comments. The final report was presented to the Boards of the participating universities and was printed after their formal acceptance.

The Committee used the 5-point rating system of the Standard Evaluation Protocol 2009-2015 (SEP). To allow greater differentiation, the Committee decided to extend the 5-point scale to a 9-point scale (1, 1.5, 2, ..., 4.5, 5) The .5 was used to indicate that a programme is between two integer ratings. The meaning of the scores is described in Appendix 2. The Committee wants to emphasise that it has taken very seriously the SEP request to consider the full range of this five-point scale and to apply the scores according to the descriptions given in the SEP. The Committee insists that the Institute and Programme leaders, as well as others who may be interested in and make use of these scores, should interpret them accordingly, and, moreover, always see them in relation to the qualitative comments.

2. General remarks

Scope of the evaluation of research in Earth Sciences

This Earth Sciences review covers the research programmes and institutes at Utrecht University (UU) and VU University Amsterdam (VU). In this section of the report the Earth Sciences Review Committee addresses some of the common themes across the two research institutes of UU (consisting of two and two research programmes) and the one research institute of VU (consisting of three research programmes).

The committee notes that the Institute for Marine and Atmospheric Research, which covers important fields in Earth Science and is a component of the Faculty of Science of Utrecht University, is evaluated separately in the framework of the UU Faculty of Science. Later this year (2015) a Review Committee will evaluate the research in (Technical) Earth Sciences at Delft University of Technology, encompassing research units in Geo-Resources, Geo-Engineering, Geology, Geophysics, Geodesy and Atmosphere. That Review Committee will have some overlap of personnel with the committee involved in the present review. The University of Amsterdam, which hosts an Earth Science component in the Geo-Ecology theme of the Institute for Biodiversity and Ecosystem Dynamics, and Wageningen University, which hosts Earth Science chair groups at the Department of Environmental Science, will organise the evaluation of their research in Earth Sciences as a component in more general research reviews.

As the current review does not cover research in Earth Sciences at the University of Amsterdam, Delft University of Technology, Wageningen University, or at the Institute for Marine and Atmospheric Research of Utrecht University, the committee could not obtain a full picture of the research in Earth Sciences at Dutch universities for the period 2008-2013. The committee has focused its general evaluation on the Earth Sciences institutes and programmes of Utrecht University and VU University Amsterdam that were involved in this review.

In the paragraphs below, the committee will elaborate on the way it has used the Standard Evaluation Protocol, particularly on some of the limitations of the protocol. Furthermore, the committee aims to address some of the common themes across the three institutes and programmes and raise some points for consideration and debate.

Gaining a clear picture of each institute and programme

Prior to the site visits, the committee received self-evaluation reports, publication lists and key publications of the institutes and programmes that participated in the review. These formed the starting point of the review and were forwarded to the members of the committee in time to be able to study them closely. The committee appreciates the considerable efforts invested in the writing of these self-evaluation reports (as noted in the preface). Nevertheless, it struggled to understand some elements of the institutes and programmes and collected additional information during and – in the case of VU University Amsterdam – after the site visit. The committee noted that the self-evaluation reports that closely followed the Standard Evaluation Protocol proved to be a valuable point of reference for the review.

The committee has endeavoured to closely follow the Standard Evaluation Protocol instructions concerning the four main criteria and their respective sub-criteria. It did find that some categories are not clearly defined (e.g. leadership), or demarcated (e.g. quality versus productivity).

With respect to academic publications, one can raise the question whether productivity (in numbers) is given too much weight in the research reviews based on the Standard Evaluation Protocol. A possible (but rather radical) solution to the dominance in numbers that was discussed within the committee could be to simply stop asking for complete lists of the academic and professional output produced by an institute or programme and to focus on a concise part of it (e.g. a programme's ten best publications per year, or each principal researcher's five or ten best publications for the whole assessment period). This approach is taken elsewhere, for example in the evaluation of academic institutions in the United Kingdom.

Further, the committee notes that the Standard Evaluation Protocol does not clearly stipulate that institutes and programmes keep track of their PhD graduates. The self-evaluation reports contained little substantial information on the careers of PhD candidates after their graduation, with the notable exception of IVAU, which in one of the appendices offered a very complete overview of PhD graduates and their career development in the period under review. The committee believes that this could be a valuable measure of the efficacy of training through research.

Sliding panels in research funding

The SWOT-analyses of most institutes reveal that in the current Dutch funding system, research programmes are becoming increasingly dependent on external funding. Regardless of the growing numbers of students, the amount of base funding provided by the government is declining. This decline has a number of consequences. First, there is added pressure to acquire external funding from national or European funding agencies and/or bring in contracts from industry. Although the programmes have mostly been successful in their efforts, as is evidenced by the overall growth of many of the programmes, this practice does add to the considerable workload of staff members, who have to somehow combine their research work with project acquisition, heavy teaching loads, supervision of PhD candidates and time-consuming administrative duties. In the long run this multitude of duties may jeopardise research productivity and, more importantly, research quality.

Second, most self-evaluation reports point out that a further decrease of direct university funding could compromise the research infrastructure itself, the continuity and quality of which are difficult to secure with 'soft money'. The committee notes that a situation in which the running of laboratory and computational facilities is solely dependent on project funding is a liability. It would therefore advise the faculties to earmark some funds for the maintenance of core facilities.

A third aspect related to the increasing dependency on external funding has to do with the specific criteria that are used by funding agencies and private companies in order to decide which research proposals are fundable and which are not. These criteria may in the long term influence the type of research that is carried out within the institutes, with applied work possibly gaining prominence over fundamental research. Opportunities for 'blue skies research' or 'curiosity-driven science' could well become scarce, even though the cultural and long-term socio-economic importance of such research is beyond doubt.

Lastly, the committee is particularly worried about the lack of start-up funding available for newly hired staff. The fact that Faculties do not have the means to provide new staff with competitive start-up packages puts the reviewed institutes at an international disadvantage.

Having the ability to provide promising candidates with start-up funds could prove vital to recruitment efforts and therefore for maintaining research quality.

The extent to which the participating institutes are, effectively, still dependent on direct funding varies heavily. At the end of the current review period, in 2013, the percentage of research fte's paid for by first stream funding ranged from 14% (IVAU) to 34% (PGRI) and 47% (AAW). This could signal that some programmes have more successfully adapted to the new funding reality than others.

One way to increase the level of direct funding has been through involvement with university-wide research priorities. The committee has noted that, during the review period, both universities under review committed firmly to 'profiling' their research around major themes with high societal relevance, such as energy, water, food, life sciences, high tech. The underlying idea was to create strong, interdisciplinary research entities that would be well prepared for the increasingly selective national and international competition for research funds. Typically, these new entities connect with the so-called *topsectoren*, interdisciplinary top priority areas for research as defined by the Dutch government, which attract an increasingly large part of the available direct funds. At Utrecht University, IVAU and PGRI play a key role in the university-wide research profile area *Sustainability*, which focuses on the transition to a society that is ecologically, economically and socially balanced. Similarly, AAW is involved in VU's research priority area *Science for Sustainability*, which aims to develop fundamentally new knowledge of climate change, energy production and responsible exploitation of natural resources. Involvement with such university-wide profile areas generates extra income and ensures a central position within the university's research.

The committee notes that short lines of communication and regular and ad hoc meetings between senior research staff and faculty and university board members are quite important. This ensures mutual understanding and the possibility to assist each other in pursuing the goals of institutes and programmes on the one hand and the objectives of faculty and university on the other hand.

Societal relevance of the Earth Sciences

Generally speaking, the societal relevance of Earth Sciences research by nature is high. The Earth Sciences study the system Earth. This encompasses the atmosphere (weather and climate), the cryosphere (land and sea ice), the hydrosphere (the rivers and lakes, seas and oceans, and groundwater), the geosphere (the surface and subsurface and the water and the volatiles deeper in the subsurface) and the interaction of these spheres with the biosphere (the interaction of living organisms with the abiotic environment).

The social and economic importance of the Earth Sciences concerns the natural means of existence (water, energy, raw materials), the terrestrial environment (including remediation of pollutions), natural hazards (such as earthquakes, volcanic eruptions, extreme weather, floods and landslides) and terrestrial space (specifically near surface and underground space), and their changes over time.

The activities of man form a significant factor in the Earth system. Therefore, the Earth Sciences also concentrate on obtaining knowledge about the influence of human activities on the Earth system along with understanding the 'natural' Earth system. The urgency and importance of this and the development of knowledge to adapt to the changing Earth are evident.

It is quite difficult for a review committee of foreign colleagues to assess all aspects of societal relevance of research institutes and programmes, and compare it robustly with the societal relevance of research executed elsewhere in the Netherlands and in other parts of Europe and the world. Nonetheless, the committee established that the research leaders, the academic staff as well as the PhD candidates with whom it had discussions, were all very aware of the societal (including economic) relevance of their research and were eager to apply – directly and/or indirectly – their knowledge and ideas. The committee is impressed with the variety of initiatives that were employed by members of the research staff in this respect.

However, compared to the scientific part of the institutes' and programmes' mission, there seems to be much less coordination of, and reward for, the work that staff members do in the societal domain. While many staff members are indeed enthusiastically and successfully disseminating their research results (e.g. developing teaching material for high schools, advising government bodies, writing op-eds), the initiative for such activities seems to be left primarily to the individual researcher. Institute- or programme-wide strategies with regard to interacting with stakeholders and creating societal impact were not found in all institutes and programmes. Considering the fact that funding decisions are significantly co-based on the expected societal relevance of proposed research projects, this should be considered as an urgent point of attention for institute- and programme leaders.

The committee suggests that the institutes and programmes undertake more structural efforts in developing and monitoring strategy plans, in order to ensure that there is a more systematic and rational approach to the demonstration and realisation of societal relevance, and that narrative as well as quantitative data are supplied. The committee notes that the revised Standard Evaluation Protocol aims to address these matters in more detail from 2015 onwards.

PhD training and supervision

The committee enjoyed meeting and talking with the PhD candidates in all the institutions. They communicated high satisfaction with their roles and work in research teams and identified strongly with their respective institutions.

The committee notes that Dutch universities host several types of PhD candidates. Most prominent are so-called 'standard' or internal candidates, who are employed by the university and are financed either through first, second or third stream funding. Within the field of Earth Sciences, employment for a period of four years is the norm, but PhD positions are increasingly paid for by NWO and industry, not by the universities themselves. The committee notes that their position as full employees of a university provides these standard PhDs with a stable base and socialises them into the expectations and standards of academic employment. A second category of PhDs, which is as yet small, but steadily increasing, consists of 'contract' or external PhD candidates (*buitenpromovendi*). These are either part-time candidates who combine their PhD project with employment outside of the university or students with a scholarship from a funding body or (foreign) government. Typically, their level of access to facilities and training is lower than for internal candidates, although the universities are increasingly making an effort to provide scholarship PhDs with the same type of PhD experience as regular candidates.

The committee notes that agreements on supervision and training of PhD candidates are commonly formalised in a 'training and supervision' plan (TSP). Formal supervision is in the hands of a full professor ('promotor'), while a daily supervisor is in charge of the quotidian supervision of the candidate. In theory, internal PhD candidates are expected to complete a

training programme consisting of both ‘skills’-courses offered at the level of the Graduate School or the central university and of (domain-)specific courses offered either at a national research school or the institute itself. In practice, training programmes with mandatory course credits (ranging up to as much as 30 EC) seem to have been formalised only recently. Up to now, the training that PhD candidates of VU and UU received could be qualified as ‘training by research’. Junior researchers master the academic *metier* by being part of their supervisor’s lab.

Until recently, the research in the Earth Sciences at the Dutch universities was organised in a system of well-established research schools. These were the CTG (Centre for Technical Geoscience), VMSG (Veningh Meinesz Research School for Geodynamics), and NSG (Netherlands Research School for Sedimentary Geology). Components of these schools formed ISES (Netherlands Research Centre for Integrated Solid Earth Sciences), one of only six top research schools in the Netherlands. The research schools ICG (Centre for Geo-Ecological Research) and SENSE (Socio-Economic and Natural Sciences of the Environment), and the entities Boussinesq Centre for Hydrology and the Darwin Centre for Biogeosciences were also connected to this system. The research schools connected all five universities in the Netherlands with limited (University of Amsterdam) to very extensive (Utrecht University) research in the Earth Sciences (see also the first paragraph of this chapter). Practically all PhD candidates in Earth Sciences were embedded in this system.

It appears that this scheme for cooperation in Earth Sciences research and training of PhD candidates of the joint Netherlands universities is disassembling gradually to be (partly) replaced by new graduate schools for each individual university. The Review Committee urges that the positive aspects of the old system (e.g. easy interaction of PhD candidates of different universities, joint scientific and educational activities, access to international scientific networks as well as to public and private stakeholders) are sustained in the newly evolving system.

The committee has established that the average completion time for standard PhD candidates in Earth Sciences with a four-year appointment currently is 4.9 years, which is exactly the cross-discipline average for Dutch PhD candidates. The committee was pleased to learn that all three participating institutes have, over the review period, made serious and successful efforts to further improve completion times.

Assessment at Institute and Programme level

3. Research review Institute for Earth Sciences, Utrecht University

3A. The institute

The institute

The Faculty of Geosciences of Utrecht University (UU) currently consists of four Departments, each with its own research institute and underlying research programmes. Two of these research institutes are part of this review: the Institute for Earth Sciences (*Instituut voor Aardwetenschappen*, IVAU), which is part of the Department of Earth Sciences and will be discussed below, and the Physical Geography Research Institute (PGRI), which is part of the Department of Physical Geography and will be discussed in chapter 4. IVAU and PGRI are jointly responsible for the bachelor's and master's programmes in Earth Sciences at UU.

The Institute for Earth Sciences conducts research into all temporal and spatial scales of System Earth, and covers core disciplines of Earth Sciences such as geochemistry, geology, geophysics, biogeosciences and hydrogeology. The Institute's mission is to advance the understanding and prediction capability of processes that govern the evolution of System Earth, from the molecular to the planetary and from the microsecond to the geological time scale. By doing so, IVAU aims to contribute – both by fundamental research and by providing input to policy and societal issues – to the grand challenges of a modern, sustainable society. Over the last decades IVAU's research is said to have developed in parallel with the international research agenda in Earth Sciences. At present, it is, for example, directly addressing Horizon 2020's societal challenge *Climate Action, Environment, Resource Efficiency and Raw Materials*.

IVAU's research is structured into two main programmes, which represent the institute's spearheads that have been in place since the early 1990's:

1. Dynamics of the Solid Earth (UU1)
2. Climate and Environment (UU2)

IVAU has long considered interdisciplinarity as an essential tool. The self-evaluation report stresses that there is not only cooperation within and between the programmes, but also with different disciplines within the Faculty of Geosciences (Physical and Human Geography and Environmental Sciences), with the Faculty of Sciences (Atmospheric and Marine Sciences, Biology and Material Sciences) and with other Dutch and international institutes. IVAU also plays a key role within one of the four research profile area's of Utrecht University, entitled *Sustainability*. It contributes chiefly to two of the three focus themes in this area: *Energy & Resources* and *Water, Climate & Ecosystems*. While the self-evaluation report holds that connections with the UU Science Faculty are already strong with regard to climate research, the growing collaboration on energy & resources might open up further opportunities.

IVAU chairs the government-funded Research School for Integrated Solid Earth Sciences (ISES), the Darwin Center for Biogeosciences, and the recently established NWO-funded Netherlands Earth System Science Centre (NESSC).

Quality and academic reputation

To illustrate its quality and academic reputation the self-evaluation report indicates that the total number of refereed journal articles has increased since the previous review period. Over

90% of the roughly 1200 refereed journal articles have appeared in journals that are included in the Thomson-Reuters' Science Citation Index (SCI), with 45% appearing in top 10% journals, and almost 75% in top 25% journals (1st Quartile). The self-evaluation report also refers to high personal scores in various rankings.

Additionally, the report highlights IVAU's tradition of bottom-up research governance, the increasing share of competitive funding in its research budget, its attractiveness to visiting scientists, and its success in influencing local, national and international research agenda's. The faculty staff is reported to be involved in formal and informal international research programmes and during the review period many members participated in international advisory boards, research review panels and scientific councils, served on editorial boards or won medals, awards and prizes from international organisations.

Assessment

IVAU is a world class Earth Science Institute. The different groups and disciplines support each other and created a cohesive environment with a high spirit. The academic reputation and the quality of research, as seen for example in the number of high-impact publications and ERC grants, amongst other indicators, is at the highest international level. The IVAU ranks within the top five Earth Sciences Institutes in Europe.

Resources

In 2013, IVAU employed 186 researchers of 25-30 different nationalities, for a total of 101.3 fte's. The two research programmes are roughly comparable in size and the staff as a whole has somewhat increased during the review period. For the past decade there has, however, been a decline of tenured staff fte's, mainly due to retirements that could not be replaced at the time because of cut backs in direct funding. The institute has been able to keep up numbers by way of externally funded PhD candidates and postdocs. Important changes occurred in January 2012, when two new research groups strengthened the institute: the Tectonics group in UU1 and the Marine Palynology and Paleoceanography group in UU2. Currently, the financial situation is said to allow replacement of recently retired staff. In 2012/2013 six young scientists were hired on tenure track positions, which reportedly reflects enhanced opportunities in terms of career development. The steadily increasing workload of permanent research staff, partly as a result of growing student numbers, is described as a threat in the self-evaluation report. Also, the male-female ratio of the staff shows room for improvement.

IVAU's expenditures have increased over the review period, from 7.9M€ in 2008 to 11.3 M€ in 2013. In a time of steadily declining first stream funding, IVAU has been able to attract new projects (including PhD and postdoc positions) from a variety of funding sources, such as research grants, contract research and EU funding, thereby increasing the external funding of research fte from 76% in 2008 to 86% in 2013. Amongst the personal grants acquired by staff members at various stages of their careers were 4 ERC Advanced grants, 5 ERC Starting grants, 12 NWO Veni grants, 5 Vidi grants and 2 Vici grants. Over the years 2007-2012 IVAU was UU's runner-up in FP7 funding.

IVAU's financial strategy is described as 'an incentive-based accounting method (*sic*) that is used to distribute direct funding for bench fees/consumables from the department level to the research groups'. While IVAU describes its financial situation as 'healthy', it is aware that a further decrease in direct funding may put pressure on the structural costs of research (tenured positions, technical and analytical support positions, infrastructure/facilities) for which it is often not possible to find external funding. Also, it acknowledges that there are no

structural funds to move into emerging fields and develop new research lines. Moreover, the trend to shift funding from fundamental to more applied sciences restricts the possibility to research the ‘unknown unknowns’ through blue-sky research. According to the self-evaluation report, new opportunities may arise from consortium-style programme funding, where multiple companies engage with a single project or programme to share benefits, results, and financial costs. Project costs in the current Dutch system are, however, high, which is said to impede IVAU’s position within the international competition for industry funds.

Access to external funding sources has enabled IVAU to modernise its existing facilities (e.g. EUROTANK Flume facility, TEC(tonic)-Lab, H(igh) P(ressure &) T(emperature)-Lab, Paleomagnetic Lab, Electron Microscopy facility, NARS seismometer network) and acquire advanced new equipment such as intermediate-size clusters of computers, HPLCMS, micro XRF, confocal laser, electron microprobe and NanoSIMS. Many of these facilities contribute to both programmes. In addition, the Faculty of Geosciences dedicates part of its direct funding to the technical and analytical support of the IVAU laboratories and the General Geolaboratories, which, according to the self-evaluation report, guarantees a solid basis with regard to support staff. For day-to-day running costs and equipment maintenance, however, the laboratories are highly dependent on project funding, which is mentioned as a weakness in the Institute’s SWOT analysis. The move to new buildings (in 2014 a new Geolaboratory building was completed, in 2017 an Earth Simulation Laboratory will be opened) will, according to the self-evaluation report, establish a closer connection with the other departments in the Faculty of Geosciences, as well as with the applied institutes TNO and Deltares. This may stimulate new cross-disciplinary research opportunities. IVAU is also a partner in the UU electron microscopy centre ‘EM square’ which will provide dedicated housing and new state-of-the-art equipment for research in life sciences, nanosciences and geosciences.

Assessment

The resources appear to be a healthy mix of funding streams with several buffers in the system. The university is committed to this and helps to provide a secure funding situation. The new buildings, including the state-of-the-art laboratory building, will further increase the already good interactions between the sub-disciplines and the individual professorships. While new faculty members do not receive individual start-up funds, they profit from the new infrastructures and analytical facilities. Even though this system seems functional for now, the committee suspects that some extra start-up incentives may be useful for future high-level recruitment.

The committee notes that the ‘Dynamics of the Solid Earth’ programme (UU1) will soon lose its ISES funding. During the site visit the committee was informed that the group will apply for an upcoming *Gravitation* call and is optimistic about the outcome. Even so, the large dependency on one particular programme is not ideal. The committee is content that the group recognises this and is already targeting the oil and other industries.

Productivity

IVAU’s productivity has increased since the previous period. The institute’s research staff produced a total of 1984 publications during the 2008-2013 period, of which 1198 articles in refereed journals (equal to an annual average of 5 refereed articles per research fte, excluding PhD fte’s). IVAU published 9 *Science*, 9 *Nature*, 18 *Nature Geosciences/Materials/Climate Change/Communications*, and 15 *PNAS* articles during the reporting period.

Over the review period, 111 PhD theses were completed, which equals 1.4 dissertations per tenured fte per year. Between 2005 and 2009, 70 standard ('employed') PhD candidates enrolled at IVAU, 34 male and 36 female candidates. Average completion time was just over 4.5 years: 3% graduated within four years and 63% completed their projects within five years. After seven years, the completion rate was 73%, while 20% of the candidates was still working on their projects and 7% had dropped out. According to the self-evaluation report, IVAU strives toward completion of all theses within the standard term of four years, but always puts the quality of the work first.

The self-evaluation report does not give information on productivity policies and publication strategies in place at IVAU.

Assessment

The committee notes that the productivity is outstanding. The publication quality and quantity is hard to top, as is the number of visible third party grants and awards. The productivity reflects the high international standing of the group as a whole.

Societal relevance

Providing input to policy and societal issues is part of IVAU's mission statement. Research activities that address current societal issues, for example those related to climate change, the sustainable use of natural resources, geo-energy, underground CO₂ storage, geo-hazards (incl. induced seismicity), environmental problems in soil, sediments and water, and eutrophication, feature in the institute's portfolio. Programme UU1, Dynamics of the solid Earth, has a focus on finding solutions for challenges in energy, resources and sustainability through research on topics such as geothermal energy, CO₂ storage and unconventional gas. Programme UU2, Climate & Environment, contributes to climate issues and related themes, such as sea-level rise.

The self-evaluation report claims that the increase in industry-funded projects (including projects funded from the new national 'Top Sector'-policy) and the new research projects obtained in 2013 under UU's own *Sustainability*-programme are indicators of a growing attention for societal relevance. Additionally, these projects with industrial partners (such as Shell, NAM, ExxonMobil, Statoil/Hydro, IF Technology, Fugro, EBN, Wintershall, Baker Hughes, GdF-Suez, Total) are thought to contribute to IVAU's visibility. With regard to contract research IVAU focuses on attracting projects that not only add to fundamental science, but are also relevant for industry and for society in general.

Outreach activities aimed at the general public are developed in close consultation with the Communications departments of the Faculty of Geosciences and the central university level. These departments help researchers in preparing press-releases for high-impact publications, manage the Faculty's social media accounts and provide media training to research staff members who contribute to radio, TV and newspaper interviews and articles. IVAU staff members also give public lectures, write or contribute to articles on popular scientific websites (e.g. Kennislink.nl) or in popular magazines, maintain public blogs about field and ocean excursions, and are involved in government advisory bodies. In recent years, a growing number of projects reserve part of their budget for outreach activities. Documentation of outreach activities only started at the end of 2012, which is why publication numbers for the review period are not significant. The self-evaluation report acknowledges that IVAU needs to improve the documentation and quantification of its various outreach activities.

Assessment

The institute's groups make a large effort to inform the broad public about new insights on climate and environmental change, geoenergy, georesources, geohazards etc. Several individuals are often in the media, ranging from television to newspapers. Within each programme, there is a 1.5 percent budget for public outreach. ERC-funded projects also have a mandatory dissemination strategy. Valorisation has grown and will grow further in the future. The programme is making a good effort to develop projects for high schools to improve the Geoscience curriculum. At the faculty level, there are also activities for a broad audience like 'Geohuis' – a platform for interdisciplinary debate. However, some individuals need help in executing a strategy for societal relevance, which would help the group as a whole.

Strategy for the future

IVAU's strategy for 2012-2016 is to deliver state-of-the-art inter-disciplinary research. The institute strongly believes in renewing research 'bottom-up' and the commitment of tenured staff is seen as a key element in fulfilling this strategy. The department board contributes with open dialogues and makes sure that externally set boundaries and rulings are applied within IVAU. According to the self-evaluation report, a broad base of tenured staff (and therefore the acquisition of significant competitive grants on the national as well as the European level) is essential for the continued success of IVAU. This is also why IVAU pursues an ambitious hiring policy.

The current financial situation is described as 'healthy' and after a long period of no or limited possibilities to hire new faculty staff, the department is now confident that retiring staff members can be replaced. This is said to help maintain IVAU's breadth of expertise, and to improve the gender and nationality balance among its faculty staff, which was not possible earlier due to a lack of new positions. The dual strategy of facilitating collaborative research while investing in individual researchers is seen as successful and will therefore be maintained in the future. IVAU aims to attract new EU and ERC funding, and also to participate in the next call of NWO's *Gravitation* programme, while at the same time maintaining strong links with industry and applied research institutions. This also requires a strong public presence. In the coming years, IVAU aims to enhance its profiling to academia, industry and public and to improve the documentation of its outreach activities.

IVAU's strategy ties in with the vision that is expressed in the report *Agenda 2020* (Royal Dutch Academy of Arts and Sciences, 2011). Building on this vision, IVAU has positioned The Earth Simulation Laboratory (scheduled to open in 2017) on the national roadmap for infrastructure and has taken the lead in one of the ten core facilities of the European Plate Observing System (EPOS). For the coming period, IVAU is looking for a way to sustainably fund its laboratories, based on permissible revolving fund rules.

Assessment

IVAU is a coherent and healthy unit with a bright future, a gem in the scientific world of the Netherlands. Diversity matters and the age mixture of the faculty is good, as is the balance of national and international appointments. For future hires, in particular to attract top international scholars, additional efforts in terms of start-up funds could be useful. The large dependence of UU1 on the outcome of a bid for funding from the *Gravitation* programme has its risks and needs to be addressed.

PhD-training and supervision

IVAU's PhD community encompasses around 75 PhD standard candidates (50:50 male-female), either financed through research grants or contract funding, or through international scholarships. The number of scholarship PhDs has grown after 2007, especially due to the yearly intake of 1 or 2 Chinese students. Additionally, IVAU has on average 30-35 external PhD candidates, who are mostly employed elsewhere (e.g. NIOZ, Naturalis) or self-funded. IVAU has no *direct* responsibilities for the training and supervision of most of these candidates, but is involved with regard to the quality of the research and the thesis. Supervisors are often part-time associated with IVAU. On average each tenured IVAU staff member supervises 2-3 PhD candidates and is advisor in a number of other internal or external PhD projects.

IVAU claims that it has developed a good monitoring system for PhD progress, although it could be implemented more rigorously to further bring down PhD duration (cf. 'Productivity'). Each internal PhD candidate has a 4-year fixed-term employment contract – with a probationary first year. During the first three months of employment, an Education & Supervision Plan is drawn up. This describes the project, the courses the candidate should follow, the mechanisms of measuring progress and the teaching duties of the candidate (max. 10% of his/her appointment). In the ninth month of employment, a 'go-no-go' decision is taken based on an assessment and development interview with the supervisor(s). After two years there is a compulsory mid-term progress report seminar, which is assessed by an independent committee. In subsequent years, there should again be assessment and development interviews between the candidate and supervisor(s). In the future, the interviews will have to be conducted by a supervision committee rather than just the supervisor. Ideally this committee will also include an external member. A PhD mentor is available for problems concerning the relation between student and supervisor(s). After completion of the PhD, a little over half of the PhD candidates accept new positions within academia, while the others pursue a career in various industries.

An important development during the current review period is that the responsibility for PhD training has shifted from national inter-university research schools to local Graduate Schools. IVAU's PhD programme is now officially embedded in the Graduate School of Geosciences, which offers general and soft-skill PhD courses, as well as some broad social PhD activities. (Earth-specific) scientific training is offered to the PhD candidates at the programme level. Supervision and monitoring of progress also take place at the IVAU level, although the Graduate School may play a bigger part in quality control in the future.

Assessment

IVAU has an international reputation for producing first rate PhD's. The PhD candidates appear to be happy with their programme, supervision, and education. PhD candidates interact well within IVAU, however, there could be a stronger connection to Physical Geography. A somewhat mandatory top level Department-wide seminar could help foster such interactions. PhD's also tend to see specialisation as the main goal of pursuing a PhD, rather than broadening out by following courses/seminars in other fields. For their future careers, extra breadth would certainly help.

Conclusion

The institute has an outstanding international reputation, which is supported by very strong publications, strategic partnerships to other national and international groups, very high external funding levels and excellent outgoing PhD's. Both programmes exude confidence and exemplify that excellent leadership at the institute and university level is important. It is a pleasure to see a committed higher administration that is (and should be) very proud of their Earth Science programmes. This provides stability and vision, which are the key fundamentals for flourishing institutes at any university.

3B. Programme level

Programme UU1 Dynamics of the solid earth

Programme leaders: Prof. dr. Jeannot Trampert
Research staff 2013: 9.6 tenured fte, 55.0 total fte

Assessments:	Quality:	5
	Productivity:	4.5
	Relevance:	4.5
	Viability:	4.5

Brief description

The multidisciplinary programme Dynamics of the solid Earth investigates the structure, dynamics and evolution of the solid Earth and its material properties over the full range of spatial and temporal scales. The programme aims to advance our understanding of dynamic processes in the Earth's crust, mantle and core, by linking observations at the surface to the physical processes operating at depth. A guiding principle is that observing and understanding the present and past is key to forecasting the future. The programme comprises two major, yet interacting, themes or research lines:

- 1) Earth structure and dynamics, with the aim to understand key tectonic processes, including their relationship with the Earth's climate,
- 2) Earth materials, to understand how processes at the atomic or microscopic scale shape large-scale processes and the evolution of solid Earth systems.

Quality

The committee notes that the strengths identified in the SWOT analysis are well supported by the documentation. The programme, since long pioneering a multidisciplinary approach, has maintained its international leadership, now strengthened with an important role in EPOS, part of ESFRI (European Strategy Forum on Research Infrastructures), through the development of some of Utrecht's top facilities: the TEC- and HPT-Lab, and the Eurotank. The existing strength in numerical modelling was expanded with the addition of the tectonics group from Amsterdam. 4 Veni, 4 Vidi, 1 Vici and 3 ERC grants show that the group has both nationally and internationally recognised leadership quality.

Productivity

Productivity is high with 4.2 refereed papers per year per *research fte* (excluding PhD candidates) and 0.9 PhD graduations per year per *tenured research fte*. In fact, output has doubled with respect to the previous period, far more than the 30% increase in research fte over the same period. The *Nature/Science* group is represented by 11 papers, indicating a healthy degree of impact beyond the more specialised geoscience domains. The PhD population is very diverse and efforts to limit transgressions of the 4-year term seem to be serious and working.

Relevance

Though much of the research emphasis is on increased knowledge of fundamental processes, many of these processes are related to hazards and geo-resources with significant societal relevance. Extensive contacts with industry exist that result in external funding with applications such as CO₂ storage and the subsidence of the Dutch gas fields. The committee does conclude that the list of outreach activities seems to rely mostly on individuals.

Viability

The committee shares the programme's confidence that the end of financing through ISES can be compensated in numerous other ways. The newly hired staff is capable of getting the needed Veni/Vidi/Vici and ERC grants, while the leadership position in EPOS, and the financing by the UU of the new Earth Simulation Lab associated with EPOS, should result in new funding from the Dutch contribution to ESFRI. A 2016 NWO *Gravitation* grant could significantly contribute to maintain momentum, and efforts to get more significant support from the oil industry – linked to the university's emphasis on fundamental research into 'Sustainability' – are under way.

Although the strategy to seek a high level of competitive external funding has been very successful so far, in the future the programme may be forced to find a new balance between fundamental science and more contract-based applied activities if more funding sources drift that way. The committee notes that care should be taken that this does not affect the strengths in fundamental research on which much of its success in the applied fields is dependent.

The strength in computational science, and the planned new laboratory facilities, form an excellent starting point to increase synergy with physical geography. For this it is important that local computational facilities, in particular intermediate-size clusters, remain available and maintained locally.

Conclusion

This is a group of very strong researchers, coherent and unified in their vision, and leading internationally. Recent retirements and an expansion have provided an influx of a new generation of equally competitive researchers. Funding through ESFRI/EPOS, *Gravitation*, and/or more industry grants will be needed in the near future, but the group has the required quality to be highly competitive.

Programme UU2 Climate and Environment

Programme leaders: Prof. dr. Jack Middelburg
Research staff 2013: 6.5 tenured fte, 46.3 total fte

Assessments:	Quality:	5
	Productivity:	5
	Relevance:	4.5
	Viability:	5

Brief description

The programme *Climate and Environment* investigates the surface and near-surface Earth system (geosphere, biosphere, hydrosphere, atmosphere and cryosphere) with all its compartments and at a wide range of temporal and spatial scales in order to advance our understanding and predictive capabilities of climate change, ocean acidification and de-oxygenation, sea-level rise, biogeochemical cycles and water resources. Process-oriented experimental studies are integrated with mechanistic models and reconstructions of past environments and climates to improve predictive capabilities for future Earth surface conditions. The programme is structured in two interacting, complementary research themes: 1) Paleoenvironments and Paleoclimate; and 2) Environmental Geosciences.

Quality

The programme *Climate and Environment* (UU2) is a world class programme in climate and environmental change research. According to the committee, it is the strongest Earth Sciences group at Utrecht University and truly outstanding. Under the current institute leadership a new state-of-the-art laboratory building has been established, which helps to attract talented young scientists. Recently, a number of excellent younger and senior staff members have been appointed and the committee notes that hiring is international and clearly successful in terms of ERC, Veni, Vidi and Vici awards. The 6 ERC grants also quantify that this programme is internationally at the very top. Resources seem to be secured with *Gravitation* funding coming in from NWO.

Productivity

UU2 is by far the largest programme in the full six years of the review period in terms of research fte's involved. Its members produced an annual average of 6.0 internationally refereed articles per *research fte* (excluding PhD candidates) and there was an average of 2.0 PhD graduations per *tenured fte* per year, which is very high. According to the committee, the group's productivity matches that of other world leading groups in its field, both in terms of overall output and – more importantly – in terms of the number of high impact publications. Its publication strategy is clearly not about mass production, but about delivering the highest quality science. The committee notes that the multidisciplinary approach is very productive, even if interaction with the geodynamics programme (UU1) could be increased further.

Relevance

Climate and ocean matter. Amplified global warming since the 1970's, a rising sea level, regional climate shifts, and extreme climate events have the potential to severely impact our planet and therefore need to be studied. Programmes such as UU's *Climate and Environment* conduct research that provides a mechanistic understanding of present and past variations in regional and global climate, and use this knowledge to optimise strategies to mitigate dangerous anthropogenic interference with the climate system. According to the committee,

UU2 is one of the leading groups worldwide in doing so and could therefore not be more relevant. Moreover, the committee concludes that there seem to be ample interactions with national agencies and research centers including the Royal Netherlands Institute for Sea Research (NIOZ).

Viability

The committee notes that the world-class leadership within this programme, and the currently perfect mix of promising young scholars, mid-career staff and senior faculty provides a wonderful perspective for the coming years, in particular with the new building and laboratories that are now in place. Having so many young faculty is clearly a plus for long term stability. The momentum of the group is outstanding, while the goals are both ambitious and realistic. The committee concludes that the future looks very bright for this group of scholars and this programme.

Conclusion

This is a group of excellent researchers, coherent, and internationally leading. Recent appointments at the senior and junior level have added to the strength of the programme, while future funding appears to be secured. In the opinion of the committee, there is a rarely seen level of mutual loyalty and commitment between the members of programme and the higher up levels of Department and University. This is a wonderful spirit worth holding on to.

4. Research review Physical Geography Research Institute, Utrecht University

4A. The institute

The institute

The Physical Geography Research Institute (PGRI) is the research institute of the Department of Physical Geography of the Faculty of Geosciences of Utrecht University. PGRI's mission is to be at the forefront of research in *Earth Surface Dynamics*; the collective name for a range of topics related to sustainability and resource availability (e.g. morphodynamics of fluvial and coastal systems, past and actual climates and environmental reconstruction, human impact on terrestrial and aquatic ecosystems, natural hazards, hydrology and water resources and geomorphology). The *river basin* is a focus point of the research.

PGRI is subdivided in two multidisciplinary research programmes, which combine fundamental scientific environmental research, spatio-dynamic modelling with field- and laboratory experiments. These are:

1. Coastal dynamics, fluvial systems, and global change (CFG, UU3)
2. Landscape functioning, geo-computation, and hydrology (LGH, UU4)

In 2012 the Palaeoecology group joined the programme UU3 (CFG). Their research on the response of individual organisms and ecosystems to natural and anthropogenically-induced environmental change is said to connect well with the research themes in both programmes.

PGRI is headed by a director of research, who represents PGRI in the Graduate School of Geosciences and coordinates external contacts. Quality control of projects and proposals takes place at the level of the programmes and the institute. Within the research programmes, the programme leaders are free to take decisions about new projects, as long as these projects fit within the mission of PGRI and are financially viable.

PGRI research is at the centre of the UU-broad research theme *Sustainability*, which focuses on the transition to a society that is ecologically, economically and socially balanced.

Quality and academic reputation

According to the self-evaluation report, PGRI is internationally reputed for its field-based and model-based fundamental research on land degradation, hydrology, and fluvial and coastal environments. Its research lines match the current agenda's of UU, NWO, TopSectors and EU's Horizon 2020 programme. Examples that are highlighted in the self-evaluation report are PGRI's research on the contribution of glaciers in the Himalayas to downstream water availability and food security; on successive vegetation transpiration adaptation under human induced CO₂ increase over the past two centuries; on global groundwater depletion and its contribution to sea-level rise; on dynamic meandering rivers; and on the transportation of sand onshore by asymmetric waves in the shallow surf zone.

The self-evaluation report also lists a number of indicators of academic esteem, such as individual grants, prizes and awards won by staff members, involvement of the staff in scientific national and international boards and committees (advisory boards, review committees, and editorial boards), invitations for keynote lectures, and the use of PGRI's software and models by institutes like EC-JRC, Deltares and ECMWF.

PGRI's strategy is to publish not only in *Science*, *Nature*, and *PNAS* but also in the top journals of its own disciplines, e.g. *Nature Climate Change*, *Nature Geoscience*, *Geophysical Research Letters*. The number of publications and citations has steadily increased over the last years along with the impact factors of the journals they appear in. In total, 435 refereed journal articles have appeared in journals that are included in the Thomson-Reuters' Science Citation Index (SCI), with 44% appearing in top 10% journals, and 73% in top 25% journals (1st Quartile).

Assessment

In many ways PGRI represents the total of the two programmes' activities – as represented in their focus, productivity, relevance, and vitality. The focus of UU3 (*Coastal Dynamics, Fluvial Systems, and Global Change, CFG*) tends to be on land-ocean connections (coastal dynamics, fluvial systems) as well as human activities that include climate change, while UU4 (*Landscape functioning, Geo-computation and Hydrology, LGH*) focuses on landscape hydrology and geo-computation (mostly hydrologic modelling). On the whole, the two programmes interface well in their research foci.

The committee's overall assessment is that the institute and programme leadership have worked very hard to establish distinct research activities at the programme level but a coordinated programme at the institute level. The leadership of PGRI is strong, energetic and forward thinking. It appears that it has thought hard about the research themes that will keep the programmes within the institutes on the cutting edge of their science. The committee recognises the benefits to the programmes' metrics (research quality, output and funding) from this leadership over the assessment period.

The implemented PGRI strategy has resulted in significant improvement of the international reputations of the research programmes, which is supported by very strong journal publications and strategic partnerships as well as very good funding levels and PhD levels. Nonetheless, the committee believes that in order to further enhance the institute's academic reputation, the programmes will need to expand their international imprint through targeted new staff hires and expanded recruitment of international PhD candidates.

Resources

Over the review period, there was an increase in PGRI's research staff, especially after 2012 when the Palaeoecology group joined CFG. In 2013, PGRI employed 73 researchers (39.7 fte), of whom 26 tenured staff members, 12 non-tenured staff members and 35 PhD candidates. The non-tenured staff (PhD candidates, postdocs) grew more steadily than the tenured staff, according to the self-evaluation report this was due to active and successful acquisition effort of the tenured staff. The two research programmes were, at the end of the review period, roughly comparable in size.

PGRI's expenditures have increased over the review period, from almost 2.5M€ in 2008 to almost 3.7 M€ in 2013. The growing staff numbers were mostly supported by an increase of second stream funding. Income from research grants doubled between 2008 and 2012, while contract research income derived from industry, government, the EC and charities decreased since 2011. The self-evaluation report states that this was mostly a result of PGRI's intensified emphasis on research grants and cut backs in expenditure by government-funded organisations like Rijkswaterstaat. In the future, PGRI would like to improve its participation in EU projects. In 2013, direct funding by the university paid for almost 34% of research fte's, while research grants and contracts paid for 43% and 23% of research fte's respectively.

The increase of student numbers contributes to the financial basis of the institute, but also adds to the pressure on staff members.

As elsewhere, PGRI's continued sensitivity to the dynamics of external funding parameters is mentioned as a weakness. Decreasing opportunities for funding basic research (both at national and European level) and changing research agendas of funding agencies pose a challenge for maintaining research lines and initiating high-risk/high-gain initiatives. Furthermore, costs and overhead for research personnel are high compared to those abroad, which may render PGRI a less attractive partner in EU projects and contract research.

The institute's research is said to closely match the strategic research agenda's of funding agencies, such as NWO (research themes *Water & Climate* and *Sustainable Energy*, as well as 'top sectors' *Water* and *Agrofood*), the European Commission (two societal challenges defined in Horizon 2020) and various EU research & innovation themes (in particular climate change, natural hazards, natural resources management, and earth observation). Acquired research grants include NWO personal grants (1 Veni, 2 Vidi's, 2 Vici's), as well as grants from the NWO Space Research User Support (US), NWO Humanities, NWO Open Competition, NWO-Technology Foundation (STW), and NWO Urbanizing Deltas (UD). The institute was also successful with regard to EC proposals (Climate-KIC, MarieCurie, Earth2Observe-FP7). Sources for contract research include EITClimate KIC and EC-KP7. Additionally, various funds for access to research facilities (HydraLab; computing time on the Cartesius National Super Computer) as well as other research contracts were acquired from ministries and companies. Furthermore, PGRI was successful in acquiring additional direct UU funding such as the UU Belle van Zuylen chair, UU-focus grants and UU Focus & Massa grants.

PGRI's research is supported by a laboratory and ICT team (5.4 fte). According to the self-evaluation report, the support is diverse, ranging from designing and constructing experimental facilities, instrument development and maintenance, logistic field support, software development, software maintenance and engineering. PGRI offers its researchers access to research facilities such as flumes, measuring frames, dating equipment, Eurotank, hydrological measurement devices as well as a computational infrastructure in terms of modelling software (PCRaster) and computational power (local multi-core servers and Cartesius supercomputer at SurfSARA). The future Earth Simulation Lab and the GeoLab and the Phytotron plantgrowth will further promote cutting-edge experimental research. Maintenance and support of these physical research facilities is a continuous concern, as software and models depend on 'soft' money.

Assessment

The institute has been very successful in terms of research funding; research grants have doubled over the 2008-2012 period. Its researchers appear to be obtaining high quality personal grants (Veni, Vidi, Vici), and achieve success in EC proposals and contract research.

The committee is of the opinion that the leadership deserves great credit with regard to optimising the human resources within the institute. Yet, to advance to the next level of quality and prominence, the leadership must develop strategies to bring in additional human resources (preferably from outside the Netherlands) and expand the institute's international imprint so to attract a larger pool of outstanding international (non-Dutch) PhD candidates. According to the committee, trying to retain PhD candidates after graduation is not necessarily a good strategy, as it does not bring in the fresh ideas that would benefit the institute and programmes.

The committee recognises that there is a strong coupling between resources and productivity. While the quality of the research in fluvial dynamics is very good, the facilities are clearly sub-standard and new investments are required. There is a concern that the quality and productivity of the institutes programmes will hit a ceiling unless new resources are provided for improved laboratory facilities (experimental, computational) and their technical support. Currently such resources are quite highly leveraged based on a diversity of sources, which makes improvements difficult, and always under risk. Wisely and fortunately, the Faculty of Geoscience and the Executive Board of Utrecht University have decided to invest strongly in a new Earth Simulation Lab, which will be completed in 2017.

Productivity

PGRI's publication strategy is described in the self-evaluation report as focusing on publications in high-impact, peer-reviewed journals rather than on book chapters and conference proceedings. PhD candidates and postdocs are expected to publish at least three or four articles in peer-reviewed journals. Tenured staff members are encouraged to aim for at least one first authored paper per year, focusing on relevant review papers. This is discussed during the annual Performance & Assessment Interview.

As a result of this policy, PGRI's productivity has increased during the review period, with the number of peer reviewed publications doubling since 2008. In total, the institute's research staff produced 1637 publications, of which 435 articles in refereed journals (equal to an annual average of 4.5 refereed articles per research fte, excluding PhD fte's). A substantial number of 753 publications falls into the category of 'other research output'.

Over the review period, 34 PhD theses were completed, which equals 0.7 dissertations per tenured fte per year. Between 2005 and 2009 30 standard ('employed') PhD candidates enrolled at PGRI, 19 male and 11 female candidates. Although PGRI aims for PhD completion within 4 years, the average duration was 4.5 years: 37% graduated within four years and 63% completed their projects within five years. After seven years, the completion rate was 70%, while 27% of the candidates was still working on their projects and 3% had dropped out. According to the self-evaluation report, PGRI aims for a balance between a high quality thesis based on peer reviewed publications and timely completion. An increase of PhD graduations is expected for the coming period, as the intake of new PhD candidates has gone up in 2013 and 2014.

Assessment

Productivity measured in journal papers is excellent, with a steady increase over the last five years. The institute's strategy of increasing the number of papers and the quality of the journals they select to publish in has clearly been successful, with ~75% of publications being in the top 25% SCI journals. The institute is commended for graduating a significant fraction of its PhD candidates within four years, and encouraged to reduce the fraction of candidates who take significantly longer.

Societal relevance

PGRI research, which is reputed in the fields of coastal and river systems, hydrology, land degradation research, earth observation and spatio-temporal modelling, is said to be relevant for society, as the institute's expertise, model outcomes and model scenarios provide a basis for sustainable use of our natural resources and for a safe living environment.

According to the self-evaluation report, PGRI is increasingly successful in acquiring funding for societally relevant issues e.g. through programmes like Climate-KIC, STW, DFID and the

private sector. As part of its ‘valorisation’ strategy, the institute has established strategic partnerships with organisations and companies that have local or national tasks in water and resources management, aiming both at enhancing its academic and its societal relevance. These have resulted in endowed chairs and external associate professorships. Examples of joint research that are listed in the self-evaluation include PGRI’s contribution to the European Flood Alert System (EFAS), collaborations with Deltares and Rijkswaterstaat on the protection and management of the Dutch coast and river systems, and with TNO, Deltares and other partners on delta architecture, reservoir characteristics and soil subsidence results. PGRI’s knowledge on earth observation and spatio-dynamic modelling contributes to studies on geography of diseases, hydrological monitoring of glaciers in the Himalayas, global modelling of water demand and availability. Furthermore, from its knowledge on paleoclimates derived from terrestrial and near-shore archives, PGRI has been able to contribute to the public debate on climate change and climate variability through a.o. the EC-COST action INTIMATE. According to the self-evaluation report, outreach activities are various and numerous. Many members are contributing to radio, TV and newspapers interviews and articles, give public lectures, and/or write articles for popular scientific websites or magazines.

Like IVAU, the institute does not (yet) structurally register output aimed at professional audiences and the general public.

Assessment

Both PGRI research programmes are highly relevant for Earth Science and for society at large. The focus areas selected by the institute are at the very cutting edge of their fields. As has been widely claimed, climate change, which is an important theme for the institute, is one of the greatest challenges facing society today, and PGRI is well positioned to contribute scientifically to this topic. While PGRI’s research is naturally very socially relevant, presenting it in a relevant manner to the public and private sectors seems to be a challenge. The committee recognises that it is hard to do everything (i.e. the science, the educational training, economic valorisation, public outreach), but there was the feeling that a more systematic approach can lead to an expansion of PGRI’s activities. There are some thoughts that PGRI may be missing opportunities related to valorisation even though on other metrics its social relevance is very good.

Strategy for the future

The self-evaluation report indicates that PGRI’s research objectives and strategy have proven successful during the review period and will therefore be continued. Owing to its ‘vibrant’ research culture, young and ambitious research staff, and increasing funding and productivity, the institute is ‘vigilantly’ optimistic about future prospects. For the next years PGRI will continue its current research themes and its tradition of experimental field/laboratory-based and model-based methods.

An anticipated change is the merger of the two programmes into one programme entitled ‘Earth surface dynamics’. This is thought to enhance the synergy between the themes and increase critical mass. Possible new research venues are basin-scale along-river sediment transport, the relation groundwater abstraction – salinisation – land subsidence – flood risk in deltas and the use of UAVs and terrestrial laser-scanning for high-resolution monitoring of morphological change throughout the river basin. Within the UU-broad research theme *Sustainability* PGRI will play a key role in research into issues such as earth surface processes, climate change and adaptation, water scarcity, hazards, biodiversity and energy at regional and global scales. The institute already acquired funding for the UU focus theme *Future Deltas*,

which provides a unique interdisciplinary, inter-faculty platform bringing together expertise in the fields of physical and human geography, physics, biology, and water and sustainability law.

The self-evaluation report also lists future challenges, which mainly have to do with the funding climate and the high burden on staff members. For example: PGRI will have to cope with increasing student numbers, which not only increase the earning capacity but also the teaching load of staff members. Increasing the efficiency in teaching, for example by introducing modern digital teaching methods, will prove necessary to safeguard staff's research time. Growth – defined in the self-evaluation report as the expansion of tenured staff members – is seen as the answer to financial fluctuations and the high administrative burden on staff. PGRI aims to supplement the existing tenured staff with talented newcomers who possess a good track record in fundraising, research and teaching. Emphasis will be put on acquiring ERC grants, EC projects and NWO funds. Research facilities like the planned Earth Simulation Lab, the EuroTank, the flumes, the expertise on environmental modelling are thought to contribute to the attractive environment at PGRI, which will stimulate foreign researchers to come to Utrecht with their personal funds. Finally, PGRI aims to reduce the average duration of PhD projects by further improving the recruitment and selection process and even more intensive coaching by increasing tenured staff.

Assessment

From the growth and development of PGRI over the assessment period and from its stated strategies, it is clear that the leadership has considerable energy and vitality as well as momentum to maintain the high standards at which the institute performs. As discussed above, the leadership does face challenges to continue the rate of increases in their productivity, quality and impact, which are related to expanding resources, facility quality, and increase in their international imprint.

The committee assessed the SWOT analysis in the self-evaluation report as realistic. The analysis shows that PGRI has significant strengths, few weaknesses (the identification of its sensitivity to funding dynamics that it has tried to buffer through funding diversity). Opportunities are perhaps under-developed. Overhead costs are a clear threat and one that the institute has limited control over. Overall, PGRI leadership recognise the various threats that exist and need to be controlled to the largest extent possible.

PhD-training and supervision

PGRI hosts both internal ('salaried') and external PhD candidates. The latter often work at other institutes (Deltares, RCE, RIVM, ITC, JRC) and combine their PhD project with regular work. PGRI also benefited from various foreign PhD candidates who brought their own funding from EC-JRC Ispra, Malaysia, Thailand or Japan.

At the start of the PhD project, the basis for supervision and training is laid down in an individual Education & Supervision Plan. PhDs are supervised by a promoter and a daily supervisor, often a postdoc researcher. Formal and informal meetings between PhD candidates and their supervisors are said to be frequent, resulting in a stimulating and innovative research environment. A collective 'PhD progress committee' evaluates the candidate's progress. A PhD mentor is available for problems that transcend the relation between student and supervisor(s). The PhD candidates of the department have organised themselves into a PhD platform and gather once a month to discuss issues such as supervision, available support from the laboratory, and daily management. Furthermore, the PhD body organises excursions, cocktail hours and other social events.

PGRI's internal PhD candidates are embedded in the Graduate School of Geosciences. Here they receive part of their training, e.g. courses in scientific writing, presentation skills, time management, scientific integrity, and specific courses such as geostatistics or paleoclimatology. PhD training further includes subjects such as design of research strategies, collection of datasets (field, lab), programming (R, Python, MATLAB), running computer models of environmental processes, analysing datasets, drawing scientific conclusions and publishing results in peer reviewed journals. Internal PhD candidates dedicate part of their time to teaching.

The self-evaluation report states that career prospects *outside of the university* are good. Graduates have found employment opportunities at a range of national and international institutes. Some excellent PhD candidates have acquired postdoc positions at UU or elsewhere.

Assessment

PGRI appears to be doing a strong job in training and supervising its PhD candidates; both in numbers and quality. Discussions with the PhD candidates indicated that the supervisors provided strong mentoring and helped foster academic independence, resulting in strong cohesion between PhDs of both programmes. Nonetheless, the committee recognises that the institute does face challenges, in meeting graduation deadlines, in countering drop-outs and in attracting more international PhDs. Increasing the number of non-Dutch PhDs would be helpful in strengthening PGRI's international reputation. Furthermore, improved links with the PhD candidate community of the Institute for Earth Sciences would help broaden the perspectives of both groups and might facilitate the further integration of the institutes.

Conclusion

Overall, the committee was content to find that PGRI has successfully developed research strategies to be on the cutting edge of the fields which it aspires to cover. Both PGRI research programmes are highly relevant both scientifically and for society at large. On all metrics its two programmes have expanded and improved over the last six years: number of research staff and funding, diversity and quality of external funding, and the number and impact of journal articles with many in the top journals in their fields. Although the committee was extremely pleased with the accomplishments within PGRI and the growth and development over the assessment period, it does feel that, going forward, PGRI should strengthen its strategy to expand its international imprint and visibility.

4B. Programme level

Programme UU3 Coastal dynamics, fluvial systems, and global change

Programme leaders: Prof. Hans Middelkoop, Prof. Piet Hoekstra (as of 2011, Prof. Hoekstra's responsibilities were partly delegated to Prof. Gerben Ruessink).

Research staff 2013: 4.9 tenured fte, 20.4 total fte

Assessments:	Quality:	4.5
	Productivity:	4.5
	Relevance:	4.5
	Viability:	4.5

Brief description

The research programme *Coastal Dynamics, Fluvial Systems, and Global Change* aims to be at the forefront of research on natural and human-induced coastal and fluvial evolution from modern to geological timescales by developing and applying innovative methodologies, to offer a challenging and well-equipped environment for young and ambitious researchers, and to contribute to the sustainable use of coastal and fluvial environments under climate and environmental change. In 2012 the chair for Palaeoecology joined CFG, thereby adding a strong actuo-palaeo ecological and climatological component to CFG's research. CFG has two key research themes:

- 1) Morphodynamics of coastal and river systems on daily to decadal time scales;
- 2) Sensitivity of river basins, floodplains, wetlands and deltas to natural and human-induced climate and environmental change on decadal to multi-millennial time scales.

Quality

UU3 combines well-established numerical and field-based research in coastal and fluvial systems with a vibrant analogue modelling programme. It makes excellent use of the scientific opportunities offered by the Dutch setting and exploits well the societal relevance of the physical processes that shape the Netherlands. This local research focus is meaningfully complemented by work in selected large fluvio-deltaic systems elsewhere and underpinned by a solid network of national and international partnerships. The programme benefits from strong leadership, which has managed to optimise recruitment of personal research grants, maintain good contacts with non-academic organisations, and foster curiosity-driven research. Although the overall quality of the programme is very good to outstanding, there is potential for further improvement: Recruitment of ecological expertise in support of bio-morphodynamic modelling would add strength in the breadth of the programme; The integration of ongoing paleo-ecological research with other research in the programme could be improved; Better equipment and technical support for imaginative flume research would yield higher quality results more efficiently; A more pro-active approach to leadership within the international scientific community is warranted and would give increased visibility.

Productivity

The publication rate is good (staff members produced an annual average of 4.4 peer reviewed articles per *research fte*) with an excellent proportion of papers published in journals with high to very high impact factors. After a period of increase, the publication trend appears to have levelled and there is limited room for growth. A key to further improvement is the actual impact of the principal publications and their longevity. The programme has consistently

supported and graduated a good number of PhD candidates (an annual average of 0.7 PhD graduations per *tenured fte*), although the graduation time could be lowered somewhat. The fact that most PhD candidates have been on standard rather than contract funding gives best perspectives for curiosity-driven research. There is potential for growth of contract PhD numbers. While faculty involved in the programme have been very successful at winning competitive personal grants, there is potential for more European funding. Junior faculty will need to differentiate themselves from substantially funded seniors in order to maximise their chances in national and international grants competitions.

Relevance

The programme is positioned at the interface of scientific and societal relevance, where funding is concentrated, and, according to the committee, it exploits the societal relevance well. Connections with stakeholders, both national and international, are strong and collaborative ties with industry are very substantial compared with most good Physical Geography departments. Some programme members have a high media profile and make a sustained and substantial outreach effort. Together this amounts to a very good to outstanding relevance score, but the programme coordinators should be encouraged to formulate a more proactive and comprehensive strategy towards demonstrating and communicating relevance, also including the development of economic spin-offs from research.

Viability

This is an established and stable team with a mature but dynamic research programme, an effective approach to funding, productivity and personal advancement, and strong leadership. The group has used the ad hominem grants system in the Netherlands very well but may have exhausted potential for growth there. Increasingly, its excellence should be used to raise European funds. Vitality of the programme can be further enhanced by careful addition of research directions, allowing recruitment of talent from neighbouring fields, and preferably with an international background. The committee notes that the future themes of 'Management of delta systems' and 'Coupling of short-term physical processes to long-term coastal-river evolution' are well chosen and should help enhance the scientific leadership position of the group. The existing core and direction of the programme should be preserved as an excellent substrate for further development. If possible, then current and future grant success should be balanced by an increase of direct funding, in order to maintain or even improve the security of the programme.

Conclusion

The committee is impressed with the sustained growth of this programme in terms of the quality, quantity and impact of its output and the level of support for its research, and convinced of the management and strategy concepts and their implementation. It is also pleased to note that there is potential for further growth and improvement, especially by increasing international recruitment, partnerships, projects and funding. They have made good use of their facilities, and those of the university, but improvements in the experimental (laboratory) set up will be needed to expand research in this area. This would lift the programme into the international top tier of research.

Programme UU4 Landscape functioning, Geo-computation and Hydrology

Programme leaders: Prof. Steven de Jong, Prof. Marc Bierkens

Research staff 2013: 3.2 tenured fte, 19.3 total fte

Assessments:	Quality:	4.5
	Productivity:	4.5
	Relevance:	4.5
	Viability:	4.5

Brief description

The research of the programme *Landscape functioning, geo-computation, and hydrology* (LGH) aims at understanding terrestrial ecosystem functioning, with an emphasis on hydrology and land degradation processes and how these processes interact with climate, vegetation, soil, and geomorphology as well as the impacts from human activities. LGH's research approach, models and results support the sustainable management of natural resources and its ambition is to be at the forefront of fundamental research on land degradation and hydrology by developing and applying innovative methodologies, as well as to offer a challenging and well-equipped environment for young and ambitious researchers. The research foci are carried out under three themes (Hazards, Land Degradation & Sustainability; Geo-Computation and Earth Observation; and Large-scale Hydrology and Hydrogeomorphology) by integrating field research, in-situ observations, remote sensing and process-based modeling that ranges from local to global scales.

Quality

Overall, the programme benefits from strong leadership that has offered a viable and successful strategic vision for carrying out research, scholarship and teaching. Programme leaders have embedded their research themes within programmes at all levels, from the university's focus on sustainability research, Dutch research themes defined by NWO (Water and Climate, and Energy Sustainability), agendas of the Dutch Technology Foundation (STW), programmes such as *Topsector Water*, amongst others. Similarly the staff have aligned their research themes well with European and international agendas such as EU Horizon 2020 and the EU research and innovation themes related to climate change, natural hazards, natural resources management, and earth observations. This alignment with funding programmes and strategic partnerships with institutions outside of Utrecht University has resulted in the programme being well positioned for a diverse funding base, quality research and a resulting strong international reputation.

Productivity

This group produced an excellent annual average of 7.2 internationally refereed articles per *research fte* (excluding PhD candidates) and there was a good average of 0.8 PhD graduations per *tenured fte* per year. The publication rate (number of journal articles per year) and the percentage in the top 10th percentile (49% of the articles), 25th percentile (76% of articles) of LGH's domain impact factors (IF) have steadily increased over the assessment period. The large positive trend of the top 10th percentile journals (from 5 to 28 per year over the assessment period) in conjunction with being published in top journals such as *Science*, *Nature Geoscience*, *Nature Climate Change* demonstrates strong productivity with quality. This is evidence that the programme's leadership strategy to encourage publishing in peer-reviewed, high impact journals has been successful. Over the assessment period, the number of tenured staff (~10) has remained fairly constant, there has been a slight increase in PhD candidates (to ~13 to 15) level, and a rather significant increase in funding (approximately 40% mostly

through an increase in research grants that tripled between 2008 and 2013.) After a dip in contract research, the numbers have increased the last few years. These numbers reflect a healthy programme, with good PhD graduation rates and support, even though the relatively high leverage through external funds requires the programme to be nimble in spotting funding opportunities. The programme has graduated a good number of PhDs, with the majority being on standard contracts (73%) as opposed to contract PhD support. The standard PhD support offers PhD candidates the best opportunity for curiosity-driven research that can lead to the high impact papers that the programme strives for.

Relevance

The strategy of the programme leaders is to interface with local, national, European and international programmes in their domain, which provides them the opportunity to have scientific and social relevance – especially at the nexus of water/climate, land use and human activities. In fact, they see themselves as providing ‘society with scientifically-based information and tools for the sustainable management of resources and dealing with the environmental challenges of global change’. Overall, the programme has exploited these themes effectively. As documented above, it has demonstrated relevance at the professional (society involvement, publications) and private (contract research, advisory boards) levels. It also strives to have a strong public presence through the popular press and media. Its production of public-oriented, scientific ‘shorts’ (e.g. on their Himalayan glacier research) is notable and of high quality.

Viability

The programme has strong leadership that has developed a long-term, strategic vision of research and scholarship that has increased the viability of LGH over the assessment period. The programme has identified research themes and areas where they can excel, and has successfully partnered with a range of groups to create a strong funding and research foundation at all administrative levels (local, national and European). The result has been a programme whose international reputation is increasing very nicely. The programme leadership recognises the effort needed to keep its momentum going forward when the funding environment is always in flux. Their strategy is to continuously attempt to identify the cutting edge of research in their areas, and to contribute to the definition of these new areas. One topic that they are actively perusing is computational science applied to their research domain (e.g. landscape modeling, global hydrology, data assimilation). Additional university support in high performance computing, technical support for ‘big data’ science, and increased opportunities for collaborations within the university, would help the programme to compete with groups in other universities who are also moving in these directions.

Conclusion

Overall, the committee was pleased with the development and improvement of the programme during the assessment period. The three themes of the programme are complementary and the programme leaders are focused to have the program working at the cutting edge of their fields. The UU helps enhance the prospects of this programme in many respects, but the programme would benefit strongly from added technical support. Looking forward, programme leaders recognize the changing research trends and have already started to position the programme. A continuing challenge is the limited number of non-Dutch PhD students, expanded EC research presence and further expansion of its international imprint.

5. Research review Institute of Earth Sciences, VU University Amsterdam

5A. The institute

The institute

The Department of Earth Sciences (*Afdeling Aardwetenschappen*, AAW) at VU University Amsterdam is one of seven departments within the Faculty of Earth and Life Sciences. The self-evaluation report states that AAW studies the Earth System with the aim to better understand the linkages and interactions between the various spheres of the Earth, deploying approaches of the interdisciplinary sciences geology, physics, chemistry and biology.

Formal responsibility for the department lies with the Head of the Department. In the first three years of the assessed period (2008-2011), the department consisted of six sections, centred on individual professors. Based on the internal 'Future AAW report' (2011), the department decided to introduce thematic clusters, aiming to provide clear research themes and clear hierarchical lines, whilst reducing the administrative burden of senior staff. Since 2012, research within the department is subdivided in three clusters, each with its own Cluster Head: Earth & Climate, Dynamic Earth & Natural Resources and Deep Earth & Planetary Science. Those clusters in turn consist of several research groups, resembling the former sections.

The mission of AAW is to develop the understanding of the Earth as an integrated dynamic system. It aims to do so by performing top-level research on the interaction between the geo-, hydro-, bio- and atmosphere, working towards international recognition. Its focus is on fundamental research. The department combines research with academic training that crosses subdisciplinary boundaries. Its interdisciplinary approach is also shaped by several joint ventures at VU University. According to the self-evaluation report, research at AAW plays an important role within the VU research priority area *Science for Sustainability*, collaborating with elements of the Faculty of Exact Sciences and the Faculty of Economics and Business Administration. Within its own Faculty of Earth and Life Sciences, AAW cooperates with the Department for Environmental Science and the Department for Ecological Sciences in the Amsterdam Global Change Institute (AGCI).

The committee has noted that during the period under review, the AAW Department, confronted with significant budget deficits, underwent several reorganisations in order to ensure its viability. According to the self-evaluation report, the transition from research groups to research clusters in 2012 was based on the termination of several large national funding programmes. Early December 2014 the Faculty Board announced yet another reorganisation, integrating three of its departments into one larger department of Earth Science, Ecology and Environmental Sciences (EEE). This reorganisation is said to make the environment of the department more stable, to allow better integration with socio-economic research and competition with the top institutes worldwide in terms of expertise, interdisciplinary capability and international reputation of staff. The self-evaluation report claims that a further embedding of the new EEE department within the Amsterdam Academic Alliance (AAA) of the science faculties of VU University Amsterdam and the University of Amsterdam (UvA) strengthens those aims. Within EEE the current clusters in Earth Science will be replaced by the clusters Geology & Geochemistry and Earth surface processes & Climate.

Assessment

Unsurprisingly, the sequence of reorganisations that were described above has involved considerable sensitivities. Just before the start of the site visit, the committee chair received a letter from a discontented member of staff. In the weeks after the site visit, two further letters followed. All three senior staff members who contacted the chairman wanted to share their concerns about the process of compiling the self-evaluation report and of selecting groups that participated in the discussions with the review committee. Furthermore, concerns were raised about the allocation of research funding. In response to these letters, the committee has given the Faculty Board the opportunity to explain its view of events, which resulted in an alternative storyline. Faced with these different storylines on the preparation of the research reviews, and ultimately on the choices made in the reorganisation, the committee has decided not to assess those aspects of the institute and programmes on which it has received conflicting or insufficient information. This mostly concerns the funding situation of the institute and certain parts of the research programmes VU2 and VU3.

Even though the committee does not want to single out specific aspects of the reorganisations, in a general sense it does want to state that the disagreements about the best course to follow, combined with a management style and financial decisions (at all levels) that lack transparency, have resulted in a weakened research programme. The institute has evidently experienced extremely turbulent times during much of the review period. The fact that a large (800K/year) budget deficit came as a surprise signals the existence of management shortcomings at all levels of the VU. The departure of much of the Tectonics group to Utrecht University in 2012 and the early closure of the strong fission track component and some parts of the isotope geochemistry component, both associated with ISES, form a serious setback that should possibly have been avoided; much of hydrology was also victim of the reorganised structure, which appears to be at odds with the plans for a shift of focus towards environmental sciences in research and teaching. In general, the committee believes that staff stability is important to having a successful research programme.

Yet a shipwreck did not happen, the institute survived and set sail again, though it has needed to adjust course at least twice. It is too early to say that it has fully weathered the elements. In the opinion of the committee, the new programmes could be more coherent. But, a clear sign of the institute's resilience is the fact that it managed to publish 150 papers per year in the review period, of which 29 are in the *Science* and *Nature* group, with only a slight dip in 2011/12. Even if output may in the short run again be affected (notably by the loss of the Tectonics group), this survival is a sign of the quality of individual researchers.

Quality and academic reputation

Part of the AAW strategy on research quality consists of an increasing focus on excellence grants. From 2012 onwards, new permanent staff is only appointed if accompanied by such grants. In the assessed period, AAW staff obtained an ERC Consolidator grant, a Vici, two Vidi and several Veni grants from NWO. A recent ERC starting grant allows expansion in 2015. Also, AAW participated in the Earth System Sensitivity proposal for the NWO *Gravitation* programme, which was awarded in 2013. The expertise of the isotope geochemistry group is also reflected by their participation in the ERC-Synergy project NEXUS1492 that investigates the impacts of colonial encounters in the Caribbean. The current leadership of the institute expressed the wish to position itself as a European top player in global (climate) change and geochemical cycles.

Assessment

There are strong senior scientists and promising young ones. The institute is a welcome partner in national and international projects, but has clearly not had much energy left to take the initiative with such collaborative projects. Once the dust of the reorganisations settles and new hires arrive, it is important that the institute finds again a role of national and international prominence, enabling it to lead others in new directions. The expected emphasis on Water Science (in EEE and with UvA), and (exo)planetary research (with UvA, and SRON) offer obvious opportunities.

Resources

Over the review period, the total research fte's at AAW averaged out at 57.9 fte. Tenured staff research fte's showed a decline, from 10.87 in 2008 to 9.22 in 2013. The self-evaluation report notes that the decline in permanent staff has continued since 2013, with numbers currently around 30 fte (7.8 research fte). The research fte in PhD candidates also shows a decrease, from 27.8 in 2008 to 23.75 in 2013. Typically, full professors have 30 percent research time available, compared to 40 percent for assistant and associate professors. PhD-students can devote 75 percent of their office hours to research, postdoctoral researchers 90 percent. However, one full professor estimated he had to spend 80% of his time on management during the recent reorganisations, leaving little time for teaching, let alone research.

The annual budget of the department in the period 2008-2013 was around €8-8.5M. It consisted mainly of direct university funding (45%) and funding through research grants and contracts (45%). Direct university funding depends on the number of completed PhD's, teaching credits and amount of awarded grants, making it fully output driven.

Personnel costs account for 75-80 percent of expenditures, reaching a level of 80 percent in 2013. In the period 2008-2013, expenditures exceeded funding by €1.3M. The necessary reorganisation in terms of personnel is almost finished: 11 staff out of total of 42 will have left by September 2015, including most hydrologists.

Assessment

As stated above, the committee has chosen not to assess the funding situation of AAW in detail. In a general sense, it notes that the strong dependence on direct funding leaves much room for an increased fraction of external funding. This will be even more urgent as the number of completed PhD's will show a (probably temporary) dip in the near future. In the current situation there is less flexibility to free existing staff for proposal preparation. There is, however, an NWO programme to support female scientists, and the emphasis on hiring only top candidates who can attract Veni and ERC awards should help.

Productivity

During the review period the research staff of the department produced a total of 1548 publications, which amounts to an annual average of 8.3 publications per *research fte* (excluding PhD candidates). Of those publications, 70% (1084) were articles in peer-reviewed journals. According to the self-evaluation report, roughly two thirds of those articles were published in journals with a top 25% impact factor in the domain. Half of the peer-reviewed articles were published in a top 10% journal. A total of 29 publications were in high profile journals such as *Science*, *Nature*, *Nature Geoscience* or *Nature Climate Change*.

Over the review period, there were 76 PhD graduations at the department, which is equal to 1.3 per year per *tenured fte*. Between 2005 and 2009 51 standard ('employed') PhD candidates

enrolled at AAW, 29 male and 22 female candidates. Almost 30% graduated within four years and almost 60% completed their projects within five years. After seven years, the completion rate was 82%, while 6% of the candidates was still working on their projects and 12% had dropped out. In addition to these 51 standard PhDs there was an influx of 13 contract PhDs between 2005 and 2009. Completion rates and times are a bit better for these external candidates than for the internal ones.

The self-evaluation report notes that the output shows an increasing number of publications aimed at the general public, rising from 4 in 2008 to 26 in 2013. It holds that the rising numbers reflect the departmental strategy to engage more with societal stakeholders.

Assessment

The output in terms of publications is high, and of high quality, which is laudable, especially considering the difficulties that were encountered in the review period. However, the committee notes that only eleven of the fifteen listed key publications have a VU affiliate as first author – indicating that some of the key research depended strongly on leadership from other institutions. The drop in PhD's, caused by transitions, hopefully will restore itself, though this may take some time far into the next review period. Meanwhile, it is important to address the rather high drop out rate of PhD candidates compared with the other institutes considered in this review.

Societal relevance

The self-evaluation report states that the research focus of both the department in general and its three clusters are providing reliable knowledge on national and international political issues such as the depletion and declining quality of natural resources (energy, water, soil and air), global change and global warming, and the reducing number of species. It holds that AAW has attuned its research focus to the Agenda 2020 (2011) by the Council for Earth and Life Sciences of the Royal Dutch Academy of Arts and Sciences. The tools and know-how of the isotope laboratory are also used for forensic purposes by various agencies.

The department aims to strengthen the societal impact of its research by encouraging networks with industry and research departments, for example by appointing professors with a background in relevant industry and organisations. It considers outreach and dissemination of the results to the general public as an important part of its policy on societal relevance. The number of publications for the general public has risen during the review period (see 'Productivity'). Research staff is said to play a major role in developing activities popularising earth sciences for pupils, in cooperation with Dutch high schools.

Last but not least, the department fulfills an import role in undergraduate teaching: 70-80 students per year for the BSc in Earth Sciences and a similar input for a degree in Earth Science and Economics. The number of MSc students has, however, dropped in 2014 due to the announced reorganisation.

Assessment

The committee notes that PhD and postdocs projects are only occasionally financed by industry. One of the PhD candidates with whom the committee spoke was supported by external funds (Shell). There are postdocs that are funded for technique-development by industry, but there is a rising trend in this type of funding that should be encouraged. While the committee recognises that service to third parties is needed to finance the expensive laboratory infrastructure, care should be taken to keep a healthy balance between applied activities and cutting-edge science.

Strategy for the future

The VU just finished defining a new institutional plan for the next six years. It was decided that the Faculty will no longer be the entity that is used to present the research to the outside world. Instead VU (like other universities) has defined four university wide research themes. These are:

1. Governance for Society
2. Human Health and Life Sciences
3. Science for Sustainability
4. Connected Worlds (humanities, informatics, theology)

These themes are all interdisciplinary and involve (staff and departments of) more than one Faculty, but no increased administrative overhead.

Plans to merge all exact sciences of UvA and VU met with resistance and were voted down by UvA student representatives, but the move of SRON from Utrecht to Amsterdam will bring SRON and Earth Sciences together in a new building at the Amsterdam Science Park (financed by VU/UvA/NWO) even though Physics and Chemistry will remain on the VU campus. This relocation is seen as a key opportunity, with the hope that it will generate additional university funding and support for AAW-scientists. In the long term (2019), joint housing of SRON and AAW is foreseen.

The self-evaluation report claims that the new departmental construct of EEE will put even more emphasis on individual talent, based on the idea that ‘the best are the most successful’. If needed, staff preparing applications for major grants are provided with greater teaching support. The current permanent staff (of 29.83 research fte and 14.85 support fte) is seen as the absolute minimum to maintain viable research in Earth Sciences. Six tenure track positions will shortly be opened as replacements for lost positions in tectonics and hydrology. These will go to the fields of hard rock tectonics, deep systems tectonics, carbonate sedimentology/petrophysics, remote sensing, nutrient transport, and climate change/water science.

Assessment

The repeated reorganisations have hit hard. Shielding from further surprises and a stable environment are a prerequisite to allow the department to find a new coherence. Although all six new positions are labeled as ‘tenure track’, the committee urges the department to actively search for one or two strong senior scientists who can help map out new directions and build enough coherence to regain an international leadership position. The embedding in EEE and the opportunity to have a voice in shaping the new building with SRON may offer an opportunity to lure a world-class scientist away from elsewhere. In the short term, some extra first-stream money may be needed to maintain laboratory facilities until new hires establish a stronger level of external funding.

PhD-training and supervision

The self-evaluation report notes that PhD candidates receive a training programme which consists of three separate elements. First, each candidate is offered guidance and supervision on his/her actual research project. Second, two national research schools – the Netherlands Research School of Sedimentary Geology (NSG) and the Research School for Socio-Economic and Natural Sciences of the Environment (SENSE) – offer topical short courses on advanced research. Last, PhD candidates receive training in transferable skills. For each PhD candidate a personal training programme balancing these three elements is established, signed by the director of either the research school or the department.

Progress of PhD candidates is evaluated on a yearly basis. PhD candidates are typically contracted for one year; if evaluated positively, they are offered a contract for the remaining period of their research project.

It is expected that the role of research schools will be taken over by a joint UvA-VU Amsterdam Graduate School.

The PhD candidates with whom the committee spoke during the site visit expressed a strong wish for more stability, better access to computer science staff for advice and improved access to the VU websites (mainly in Dutch) for international students.

Assessment

The staff has done a very good job keeping the graduate school functioning despite distractions, and managed to create an atmosphere in which PhD candidates feel comfortable. There is some concern as to the average duration of the PhD research (cf. under 'productivity'). Furthermore, the committee feels that PhD candidates should be allowed to organise a department-wide weekly seminar series with both local speakers (which can help create coherence) and invited speakers. Seminars should be understandable for all PhD candidates, such as to broaden their view. The department should use the visits by external speakers to promote their newly found coherence, and use it as an opportunity to evaluate potential new hires.

Conclusion

The institute has gone through an extremely turbulent period, but nevertheless achieved a publication record that is high in both quantity and quality. The next three or four years will be decisive for the viability of Earth Sciences at the VU. It is imperative to find more coherence, both within individual programmes and at the institute level while anticipating the move towards a new department EEE. Priority should be given to stimulate leadership by new and existing talented faculty that can work constructively with the higher levels of the university administration in rebuilding the institute and give it more organisational and financial stability. The survival and health of a broad Earth Sciences programme at the VU is essential to the balance and depth of this field in the Netherlands.

5B. Programme level

Programme VU1 Earth and Climate

Programme leaders: dr. Gerald Ganssen
Research staff (2013): 4.26 tenured, 34.10 total

Assessments:	Quality:	4
	Productivity:	4.5
	Relevance:	3
	Viability:	3.5

Brief description

The cluster Earth and Climate was established in 2012 and consists of three ‘research lines’: Marine Biogeology, Climate Change & Landscape Dynamics, and Global Biogeochemistry. The cluster aims to combine experimental and paleoclimate data acquisition knowledge of both terrestrial and oceanic processes to better understand the modern and past climate system. It has defined two main research goals:

- Understanding the evolution and variability of the Earth’s Climate in terms of forcing, processes, controlling factors and feedbacks involved in oceanic, terrestrial, and atmospheric transport of heat, water and sediments.
- Quantifying the changes and evolution of selected terrestrial, coastal and ocean environments’ key biogeochemical cycles and water, both in terms of internal dynamics and in the response of these systems to natural and anthropogenic changes in climate, including its internal and external forcing and controls.

Quality

Despite the difficulties at VU, the programme is carrying out high quality research, is successful in attracting external research funds and has a robust PhD training programme. The number of publications, also in high-impact journals, is very good. The leaders of the three themes are individually strong researchers that have the ability to provide a long-term strategic direction to the programme.

In the self-assessment it is stated that “the general direction and size of the research efforts associated with the respective themes are increasingly managed by the individual staff members in consultation with the three sub-group leaders.” While the benefit of such a ‘hands-off’ approach for younger staff is the potential to develop, the downside for the programme is that research activities are dispersed. The level of cohesion within the programme needs to improve. The discontinuation of an important chair is seen as a major loss to this programme.

Overall, the programme has a strong academic reputation. The high quality of the programme’s journal publications enhances this reputation, as does its participation in a number of (pan-European) collaborations, which has brought in external funding. Resources appear to be fine, however, the commitment of the higher administration to the programme remains unclear.

Productivity

Productivity measured in both research funding and journal papers is admirable. On average the programme produced 6.0 refereed articles per *research fte* per year (excluding PhD candidates). The programme members have an excellent record of refereed articles and the percentage in the top tier is very good. The number of papers in very high impact journals (*Nature, Science* etc.) is very good. This productivity enhances the program's reputation.

Furthermore, there was an average of 1.7 completed PhDs per year per *tenured* staff member. First stream funding has increased with the growing number of PhD candidates.

Relevance

The self-assessment report and the group presentation in this area were rather weak. Essentially the programme believes that working in an area of interest to society makes the work socially relevant. The committee feels that this programme could and should make their work more accessible to the public through outreach. There is no discussion of 'valorisation' of their research activities.

Viability

The programme is vital but the cohesion is not sufficient. The turmoil at VU of the past years has clearly damaged the programme. The plan to hire several young faculty will certainly help it to maintain its academic position, but probably will not advance the programme's reputation and will not provide the additional leadership that will be important during the coming years.

Regarding robustness and stability, the group has high quality staff, its reputation is still strong, and it is very productive. However, it is apparent that several developments at VU will be critical if not fundamentally changed. The group needs to become more coherent and the relationship to the higher administration needs to improve. Recent reorganisations have not been very helpful in terms of increasing coherency or improving the relationship to the higher administration. In order to ensure stability in the future, a strong commitment from the higher administration is of vital importance.

Conclusion

This is a group of strong researchers who would benefit from a higher coherency and a joint vision. The program has suffered from the numerous problems at VU during the past years and will benefit from new faculty appointments. While several new junior professors are part of the hiring strategy, it would be strongly recommended to actively search for one, or - preferably - two top independent senior scholars who have not been engaged in the conflictual situations of the recent past.

Programme VU2 Dynamic Earth and Natural Resources

Programme leaders: Prof. dr. John Reijmer
Research staff (2013): 2.64 tenured, 7.48 total

Assessments:	Quality:	n/a
	Productivity:	n/a
	Relevance:	n/a
	Viability:	n/a

Brief description and general remarks

The cluster Dynamic Earth and Natural Resources (DENS) was established late 2011, by uniting the subjects Tectonics, Carbonate Sedimentology and Hydrology. Around that time the leadership of the large and influential Tectonics group, unhappy with management of the Earth Sciences at the VU, had decided to migrate activities of the *Toponderzoeksschool Integrated Solid Earth Sciences* (ISES) to Utrecht University. Only some staff involved in the teaching of tectonics remained at the VU and joined programme VU2. In 2012 part of the Hydrology group and the Geo-Environmental Sciences group formed the *Amsterdam Critical Zone Hydrology Group* (ACZHG). A further reorganisation, motivated by a need to close the Institute budget, was decided in 2014, based on a report drafted by ‘young professors’. Programme VU2 was not represented in the writing group. The reorganisation entailed discontinuation of the programme VU2, ramping down of the hydrology group and transfer of carbonate sedimentology and tectonics to a new, larger programme.

In the committee’s opinion, the now discontinued programme can’t be assessed fairly without due regard for the organisational context within which it emerged and operated. The history of change described above means that the programme as presented in the self-assessment has existed as a unit only for part of the assessment interval and does not exist anymore. The committee feels that it is impossible to evaluate VU2 in the same way as the other programmes under consideration and it has decided to desist from any quantification of evaluation criteria. For a further explanation of the procedure followed by the committee, please see the Institute assessment, p 41.

In its meeting with representatives of VU2, the committee found a high degree of disaffection with Institute and higher management. The programme speakers felt that they had not been actively involved in the 2014/15 reorganisation; that their interests had not been properly represented at the Institute level; that their substantial contribution to teaching had not been given due credit; that the research groups involved in the programme had not been given enough time to demonstrate individual viability and collective synergy; that the lack of organisational stability made it impossible to define and pursue a scientific and funding strategy; that this persistent volatility has meant that members of the Institute have looked chiefly after their own interests; that there was a need for more bottom-up shared vision and less ‘hard-handed’ top-down management; and that the hydrology group was unfairly held responsible for ‘negative department results’.

Quality

The committee concludes that this programme was an artificial construct rather than a functional unit. It assembled discipline groups with limited prior interaction and participants were not given time to develop meaningful collaborations. The core of the Tectonics group departed for Utrecht at the inception of the programme, but its activities prior to 2012 are

reported here. The individual groups within the programme have their merits in research and teaching, including the internationally recognised scientific leadership of the Tectonics group, the highly specialised Carbonate Sedimentology research and the essential contributions of the Sedimentology and Hydrology groups to teaching at undergraduate and masters levels. The programme had insufficient leadership and an apparent deficiency of strategic planning has resulted in a lack of cohesiveness. This was exacerbated by the failure to retain well-qualified junior faculty. The remaining part of the Tectonics group did not offer clear research perspectives. Budding synergies between the Sedimentology and Hydrology groups, with interest and potential, have been truncated prematurely. Although this programme has been hostage to external decisions, its coordinators have failed to develop and project sufficient strength over the short life span.

Productivity

The committee has not been able to discern a productivity strategy and any trends are obscured by changes to the programme composition during the evaluation period. It must be stressed, though, that the individual groups were remarkably productive in terms of publications, given the challenging operational environment. On average they produced 7.0 refereed articles per *research fte* per year (excluding PhD candidates). The groups have maintained a very good share in top 25% IF journals, although an insufficient number of key publications was produced in-house. Moreover, the departure of the productive part of the Tectonics group was followed by an increase in the publication rate of the remaining groups, especially Hydrology. The number of doctoral researchers was sub-optimal (although there was an average of 1.0 PhD graduations per *tenured fte* per year), with one PhD graduated from the Sedimentology group and most PhDs associated with the Hydrology group were external PhDs based elsewhere. This reflects, in part, the weak funding base for research in these areas. The programme did not have a balanced funding portfolio and raised insufficient support through external grants and contract research.

Relevance

The Carbonate Sedimentology group has a sustained tradition of economic valorisation. The Hydrology group has engaged with some topics with high societal relevance at the international rather than national level. Tectonics research within ISES was driven by fundamental questions, although the team has effective links with stakeholders and industry, and delivers crucial service to the European research community at high level. However, for the programme as a whole, a valorisation strategy is not reported and a pro-active approach, integrating associated research partners, e.g. sedimentology and paleoceanography, appears to have been lacking.

Viability

The committee is under the impression that this programme had limited viability from the start and has not been granted a future. The surviving components require attention, support and refocusing. Carbonate Sedimentology continues to play an essential role in the teaching programme of the Institute. To offset this time commitment, an investment should be made in personnel expansion at the junior faculty level. The intended shift of research focus to petrophysics and the geochemistry of fluid inclusions is likely to bring a better alignment with strengths of the Geology and Geochemistry programme. For research in Tectonics, an entirely new base must be established through appointment of junior faculty. A single appointment is not likely to give critical mass. In hiring new faculty, careful attention should be given to avoiding overlap with the Solid Earth programme at Utrecht University. The committee observes that the discontinuation of the Hydrology group, which had started to

show signs of vitality, will affect the ability of the VU to sustain a planned EEE programme independent of UvA participation if the intended synergy between universities does not materialise.

Conclusion

Whether deliberate or by accident, this programme was at the heart of the storm at the VU AAW. It lacked coherence from the start and perished due to poor management at all levels. The fact that adverse conditions have not caused the productivity of individuals to drop to rates below those found in other evaluated programmes illustrates that well defined programmes and high-level strategies are not always a key to progress in science. That said, the programme elements which have been chosen for survival are valuable not only to the Institute, but also in complementing existing strengths elsewhere in the Netherlands. These elements must be given significant time and support in order for them to regain vitality. Critical errors committed in the definition and running of this programme must be identified and repetition must be mitigated against.

Programme VU3 Deep Earth and Planetary Sciences

Programme leaders: Prof. dr. Gareth Davies
Research staff (2013): 2.32 tenured, 12.84 total

Assessments:	Quality:	4
	Productivity:	4
	Relevance:	4
	Viability:	4

Brief description

Prior to the introduction of the clusters in 2012, four groups performed research on Solid Earth: Petrology, Sedimentology, Tectonics and Isotope Geochemistry. In 2010 Petrology was joined by the Argon Geochronology section that was part of Isotope Geochemistry. In 2012, the new Deep Earth and Planetary Science (DEPS) cluster was introduced, while the majority of the Tectonics group left VU University. The cluster incorporated the remaining members of the Tectonics group whose research focused on high temperature processes.

In the committee's opinion, the available information insufficiently allows a fair assessment of the contribution of parts of the DEPS cluster – Tectonics, Isotope Chemistry – to the overall research performance. The committee has therefore desisted from scoring these aspects of the current DEPS group. For a further explanation of the procedure followed by the committee, please see the Institute assessment, p. 41.

The mission of the Deep Earth and Planetary Sciences cluster is to quantify the major driving forces that shape the earth, moon and terrestrial planets, using field, petrological and geochemical techniques, and with a particular emphasis on developing new experimental and analytical techniques to study processes controlling planetary differentiation and processes occurring at the biosphere-geosphere interface.

Quality

The DEPS cluster brings together several strong and established research groups, mostly configured around analytical techniques. Their know-how is widely appreciated, and has led to collaborations with teams elsewhere, both within the Earth Sciences and in other disciplines. Members are actively participating in international programmes, among which several space missions. However, the committee feels that the diversity of the research objectives affects the cohesion of this programme, and not all its components are effectively linked. This, and the apparent strategy to focus on areas left open by other institutions, makes it difficult to discern a true international leadership position with a core research agenda for this programme. Some programme members have shown to be competitive for NWO's individual grants, while others are winding down long-running programmes. With the addition of Sedimentology and a projected strengthening of Tectonics, the programme will gain further breadth. Cohesion and stability will be key to any quality improvements.

Productivity

The committee notes that the programme's members are productive (on average they produced 4.4 refereed articles per *research fte* per year and 1.0 dissertations per *tenured fte* per year), but a proactive strategy is not formulated. Part of the current productivity is linked to work in support of scientific efforts coordinated elsewhere. Programme leaders identify the lack of resources for new instruments as a bottleneck. To improve productivity, the analytical facilities must be supported at an internationally competitive level, and used primarily to

sustain research lead by programme members. The number of PhDs is relatively small, and completion times are too long.

Relevance

The committee has found insufficient evidence of systematic and substantial interactions with stakeholders, except in forensic applications of isotope geochemistry. Some individuals in the programme clearly have good ties with stakeholders and industry, but the picture is not homogeneous. Strong aspects of the research programme are mediagenic, generating prime material for outreach efforts. Coordinated use of this could help enhance funding chances and impact the programme quality in the long run.

Viability

The group is badly in need of consolidation after many changes in the recent past. Except for a common focus on analytical tools and techniques, the links between its components are not always clear. With the merging and planned expansion into a larger cluster, the research programme will broaden further, and the committee feels that the short-term strategy should be to build synergy between the different research objectives. The link with space science is a big plus, especially with SRON moving to Amsterdam. Effective use of available tenure track positions to attract and keep internationally leading young scientists in key fields and effective coordination of this effort with the University are essential. According to the committee, these positions must be supported such that recruits can tap into external funding with maximum efficiency.

Conclusion

The focus on curiosity-driven research introduces vulnerability in the current Dutch funding climate, which demands higher funding rates from other streams. The hiring of core staff in new fields may require further substantial investments in equipment, and care should be taken to find a good balance between the core research, external collaborations, and service activities meant to finance key infrastructure and its maintenance.

Appendices

Appendix 1: Curricula vitae of the Committee members

Hessel Speelman (chair) received his academic education at Groningen University (BSc geology/geophysics; 1971), Leiden University (geophysics/sedimentology) and the Vrije Universiteit Amsterdam (MSc hydrogeology; 1974). Then he did geological research in Indonesia and worked as a researcher at the Vrije Universiteit Amsterdam. After obtaining his PhD (Amsterdam; 1979) he worked as a hydrogeologist in Colombia. In 1982 he was appointed geoscientific expert at TNO in the Netherlands. From 1988 to 2005 he held senior management positions of geoscientific knowledge institutions (i.e. general director of the Netherlands Institute of Applied Geoscience TNO – National Geological Survey). In addition, he held board positions from the early 90s onwards at institutions which are part of the Dutch knowledge infrastructure related to earth and life sciences (including KNAW, NWO, and universities) and at organisations related to geo-information and at European geoscientific associations and the EU. From 2005 to 2008 he worked – affiliated with the Netherlands Innovationplatform – on developing ideas for improving the public knowledge infrastructure of the Netherlands. From 2008 to 2012 he was advisor ‘renewal public knowledge infrastructure’, board member (portfolio: geoscience) of the WaddenAcademy KNAW and chairman/member of supervisory boards. Since 2013 he is vice-chairman and geoscientist of the WaddenAcademy, chairman of the steering group long-term subsidence in the Wadden Sea Region and chairman of supervisory boards in the field of earth and life sciences. From 1998 – 2015 he participated/participates in audits and reviews to assess research [programs and institutions] in the EU.

Gerald H. Haug is Ordinary Professor for Climate Geology at ETH Zürich. He is trained as a geologist (Diplom, University of Karlsruhe, 1992) and received his PhD from the University of Kiel in 1995. He habilitated at ETH Zürich in 2002. Haug’s research aims to elucidate the largescale feedbacks acting on Earth’s environment and climate, biological, chemical, and physical. His main approach has been the analysis of ocean and lake sediment sequences with diverse geochemical proxies. He enjoys to bring new analytical methods to bear on fundamental paleoenvironmental questions that often speak to the environment-society nexus. Working across a broad range of time scales and environments, Haug has made several contributions to our understanding of interactions among climate, the ocean, the carbon cycle, and societies. Haug has coauthored more than 100 peer-reviewed publications. Amongst other recognitions, Haug has been awarded the Gottfried Wilhelm Leibniz Prize of the German Science Foundation, the Max Rössler Prize of ETH Zürich and is a member of the German Academy of Science ‚Leopoldina‘ and Academia Europaea.

Niels Hovius is Professor of Earth Surface Dynamics at the University of Potsdam and heads the Geomorphology Section at the German Research Institute for Earth Sciences GFZ. He holds degrees in Physical Geography and Earth Sciences from Utrecht University and a doctorate from the University of Oxford (1995). After postdoctoral stints at Trinity College Dublin and the Pennsylvania State University, he taught Earth Sciences at the University of Cambridge from 1999 to 2012. In this period, he was a fellow of Churchill College and a research associate at the Lamont-Doherty Earth Observatory of Columbia University. He has held visiting professorships at the Universities of Oslo (Norway) and Rennes (France) as well as the Institut de Physique du Globe in Paris and the ETH Zürich. In 2012, Niels moved to the GFZ with a life-long grant from the German Helmholtz Gemeinschaft, to set up a multi-disciplinary research group investigating Earth Surface Dynamics. He is a co-founder and past president of the Geomorphology division of the European Geosciences Union and a founding editor of the journal Earth Surface Dynamics.

His principal research interests are in the mechanisms and patterns of erosion and its role in lithospheric deformation and global biogeochemical cycles.

Guust Nolet is George J. Magee Professor of Geophysics, emeritus, at Princeton University, where he taught from 1991-2007, and emeritus professor at the Université de Nice/Sophia Antipolis where he taught until 2014. He obtained his PhD in geophysics (1976) at Utrecht University where he also remained at the start of his career. He built the first portable array of broadband seismometers (NARS), and more recently the first network of floating submarine seismometers (Mermaid). He developed algorithms for large-scale seismic tomography, and introduced the 'finite-frequency' methods that led to the first images of thermal plumes in the lower mantle. He has served the Incorporated Research Institutions of Seismology (IRIS) as member of the board of directors and in various other functions. He served on numerous committees and scientific panels, and as editor or associate editor of major journals. He is a member of the American Academy of Arts and Sciences, the Academia Europea and a corresponding member of the Royal Netherlands Academy of Sciences, and is a Fellow of the AGU. Among his honours are a Cecil H. and Ida Green Fellowship at the Scripps Institute of Oceanography, the Gutenberg medal and the Bownocker Medal.

Eric F. Wood holds the Susan Dod Brown Professorship in Civil and Environmental Engineering at Princeton University, where he has taught since 1976. His research area is in hydroclimatology with an emphasis on the modelling and analysis of the global water and energy cycles through land surface modelling, satellite remote sensing, and data analysis. His foci include the monitoring and forecasting of drought, hydrologic impacts from climate change, and seasonal hydrological forecasting. He participates in WCRP's Global Energy and Water EXchange (GEWEX) activities to develop long-term Climate Data Records of the terrestrial surface heat flux data sets for climate studies. He is/has been a Science Team member on the NASA Aqua/Terra AMSR-E and MODIS instruments, the NASA Global Precipitation Mission (GPM) mission and the NASA's soil moisture SMAP mission. For UNESCO he has guided the development of a Global Flood and Drought Monitoring and Forecasting system. Among his honours, Dr. Wood received a *Doctor Honoris Causa* from Gent University (Belgium) in 2011; a member of the U.S. National Academy of Engineering, a Fellow of the Royal Society of Canada, a Foreign Fellow of the Australian Academy of Technological Sciences and Engineering (ATSE), a Fellow of the American Geophysical Union (AGU) and the American Meteorological Society (AMS), and a Honorary Member of the European Geosciences Union (EGU). He has received numerous medals and awards for his global drought research and has served on numerous committees and advisory panels.

Appendix 2: Explanation of the SEP scores

Excellent (5)	Research is world leading. Researchers are working at the forefront of their field internationally and their research has an important and substantial impact in the field.
Very Good (4)	Research is nationally leading. Research is internationally competitive and makes a significant contribution to the field.
Good (3)	Research is internationally visible. Work is competitive at the national level and makes a valuable contribution in the international field.
Satisfactory (2)	Research is nationally visible. Work adds to our understanding and is solid, but not exciting.
Unsatisfactory (1)	Work is neither solid nor exciting, flawed in the scientific and/or technical approach, repetitions of other work, etc.

Quality is to be seen as a measure of excellence and excitement. It refers to the eminence of a group's research activities, its abilities to perform at the highest level and its achievements in the international scientific community. It rests on the proficiency and rigour of research concepts and conduct; it shows in the success of the group at the forefront of scientific development.

Productivity refers to the total output of the group; that is, the variegated ways in which results of research and knowledge development are publicised. The output needs to be reviewed in relation to the input in terms of human resources.

Societal relevance covers the social, economic and cultural relevance of the research. Aspects are:

- societal quality of the work. Efforts to interact in a productive way with stakeholders in society who are interested in input from scientific research, and contributions to important issues and debates in society.
- societal impact of the work. Research affects specific stakeholders or procedures in society.
- valorisation of the work. Activities aimed at making research results available and suitable for application in products, processes and services. This includes interaction with public and private organisations, as well as commercial or non-profit use of research results and expertise.

Vitality and feasibility. This dual criterion regards the institute's ability to react adequately to important changes in the environment. It refers to both internal (personnel, research themes) and external (developments in the field, in society) dynamics of the group. On the one hand, this criterion measures the flexibility of a group, which appears in its ability to close research lines that have no future and to initiate new venture projects. On the other hand, it measures the capacity of the management to run projects in a professional way. Policy decisions and project management are assessed, including cost-benefit analysis.

Appendix 3: Programme of the site visit

Research Review Earth Sciences, January 20th-23rd, 2015				
Day 0	January 20th			
	19:00	22:00	Arrival at Crowne Plaza Hotel South (George Gershwinlaan 101, 1082 MT Amsterdam) and Committee dinner at Gustavino (Gustav Mahlerplein 16, 1082 MA Amsterdam)	
Day 1	January 21st		VU University Amsterdam, Institute for Earth Sciences, De Boelelaan 1085, room P-423	
		8:30	Arrival of the committee	
	8:30	11:30	Committee meeting, incl preparation VU	
	11:30	11:45	Welcome by rector / dean VU	<ul style="list-style-type: none"> • Prof. dr. Frank van der Duyn Schouten (rector magnificus) • Prof. dr. Hubertus Irth (vice dean) • Prof. dr. Wim van Westrenen (head of department since 1/1/2015) • Prof. dr. Han Dolman (head of department until end 2014)
	11:45	12:45	Meeting with management Institute for Earth Sciences	<ul style="list-style-type: none"> • Prof. dr. Wim van Westrenen (head of department since 1/1/2015) • Dr. Gerald Ganssen (VU1 leader, management team) • Prof. dr. John Reijmer (VU2 leader) • Prof. dr. Gareth Davies (VU3 leader, management team) • Prof. dr. Han Dolman (head of department until end 2014)
	12:45	14:00	Lunch and tour of the facilities	<ul style="list-style-type: none"> • Mineral separation laboratory • Ultra sensitive mass spectrometry • Light isotope mass spectrometry
VU1	14:00	14:45	Meeting with representatives VU1 (Earth and Climate)	<ul style="list-style-type: none"> • Dr. Gerald Ganssen (associate prof, VU1 leader) • Prof. dr. Hans Renssen (full prof) • Prof. dr. Han Dolman (full prof)
	14:45	15:00	Evaluation programme VU1	
	15:00	15:15	Tea break	
VU2	15:15	16:00	Meeting with representatives VU2 (Dynamic Earth)	<ul style="list-style-type: none"> • Prof. dr. John Reijmer (full prof, VU2 leader) • Dr. Hubert Vonhof (associate prof) • Dr. Henk Kooi (associate prof) • Prof. dr. Gareth Davies (full prof)
	16:00	16:15	Evaluation programme VU2	

VU3	16:15	17:00	Meeting with representatives VU3 (Deep Earth)	<ul style="list-style-type: none"> • Prof. dr. Gareth Davies (full prof, VU3 head) • Prof. dr. Wim van Westrenen (full prof) • Dr. Klaudia Kuiper (associate prof)
	17:00	17:15	Evaluation programme VU3	
	17:15	17:30	break	
	17:30	18:15	Meeting with PhD researchers Institute for Earth Sciences (VU1/VU2/VU3)	<ul style="list-style-type: none"> • Katrin Fleischer (PhD Candidate 4th yr VU1) • Ove Meisel (PhD Candidate 1st year VU1) • Yurui Zhang (PhD candidate 2nd year VU1) • Alice Knaf (PhD Candidate 1st yr VU3) • Jurrien Knibbe (PhD Candidate 2nd year VU3) • Luuk Kleipool (PhD Candidate 4th yr VU2)
	18:15	19:00	Committee Meeting	
	19:30		Dinner at Restaurant La Sirène (Apollolaan 2, Amsterdam)	
Day 2	January 22nd		Utrecht University, Institute for Earth Sciences (IVAU), Gebouw Aardwetenschappen, Budapestlaan 4 (entrance at Princetonplein), room Z.220	
	8:15	9:30	transfer to Utrecht and welcome by the dean UU	
	9:30	10:30	Committee Meeting, incl preparation IVAU	
	10:30	10:45	break	
IVAU	10:45	11:45	Meeting with management IVAU	<ul style="list-style-type: none"> • Prof. dr. Jeannot Trampert (head of department / research director and leader IVAU prog 1 until end of 2014), • Prof. dr. Jack Middelburg (research director since 1-1-2015 / leader IVAU prog 2), • Drs. Jan-Willem de Blok (managing director)
	11:45	13:00	Lunch and lab tour along some highlights in the new Geolab building, accompanied by Prof. Dr. Martyn Drury, Prof. Dr. Lucas Lourens, Dr. Francien Peterse	
UU1	13:00	13:45	Meeting with representatives programme UU1 (Dynamics of the solid earth)	<ul style="list-style-type: none"> • Prof. dr. Chris Spiers (full prof) • Dr. Oliver Plumper (assistant prof) • Dr. Douwe van Hinsbergen (associate prof) • Prof. dr. Jeannot Trampert (full prof, programme leader)
	13:45	14:00	Evaluation programme UU1	

UU2	14:00	14:45	Meeting with representatives programme UU2 (Climate and Environment)	<ul style="list-style-type: none"> • Prof. dr. Majid Hassanizadeh (full prof) • Dr. Francien Peterse (assistant prof) • Prof. dr. Appy Sluijs (full prof) • Prof. dr. Jack Middelburg (full prof, programme leader)
	14:45	15:00	Evaluation programme UU2	
	15:00	15:15	Tea break	
	15:15	16:00	meeting with PhD researchers IVAU	<ul style="list-style-type: none"> • Lydian Boschman (year 1, prog 1) • Claudia Giese (year 1, prog 2, external employment) • Dan Palcu (year 2, prog 1) • Thomas Sweijen (year 2, prog 2) • Miao Zhang (year 3, prog 1, China scholarship) • Matthias Egger (year 3, prog 2) • Inge van Gelder (year 3, prog 1) • Vittoria Lauretano (year 4, prog 2)
	16:00	18:00	Committee Meeting and preparation PGRI	
	18:30		Dinner at Restaurant Karaf (Lange Nieuwstraat 71, 3512 PE Utrecht)	
	22:00		Check-in at Hotel MaryK (Oude Gracht 25, Utrecht)	
Day 3	January 23rd		Utrecht University, Physical Geography Research Institute (PGRI), Van Unnikgebouw, Heidelberglaan 2, room 1015A	
		8:30	Arrival of the Committee	
PGRI	8:30	9:30	Meeting with management PGRI	<ul style="list-style-type: none"> • Steven de Jong (Director of Research) • Marc Bierkens (Head of Department) • Marjan Rossen (Managing Director)
UU3	9:30	10:15	Meeting with representatives Programme UU3 (Coastal Dynamics, Fluvial Systems, and Global Change)	<ul style="list-style-type: none"> • Hans Middelkoop (Professor of Global Change Geomorphology) • Gerben Ruessink (Professor of Coastal Morphodynamics) • Rike Wagner (Professor of Paleophysiology & Environmental Change) • Maarten Kleinhans (Professor of Process Sedimentology)
	10:15	10:30	Evaluation programme UU3	
	10:30	10:45	Break	
UU4	10:45	11:30	Meeting with representatives programme UU4 (Landscape functioning, Geo-computation and Hydrology)	<ul style="list-style-type: none"> • Steven de Jong (Professor of Land Degradation & Geoinformatics) • Marc Bierkens (Professor of Hydrology) • Derek Karssen (Assoc Professor of Geocomputation & Hydrology) • Geert Sterk (Assoc Professor of

				Land Degradation)
	11:30	11:45	Evaluation programme UU4	
	11:45	12:30	Meeting with PhD researchers PGRI	<ul style="list-style-type: none"> • Anne Baar (PhD Candidate 1st yr) • Philip Minderhoud (PhD Candidate 1st yr) • Anouk de Bakker (PhD Candidate 3rd yr) • Arthur Lutz (PhD Candidate 2nd yr, External) • Harm-Jan Pierik (PhD Candidate 3rd yr) • Niko Wanders (PhD Candidate 4th yr) • Stefanie Pessenteiner (PhD Candidate 1st yr)
	12:30	13:45	Tour of PGRI facilities and lunch	<p>Flume experiments (basement):</p> <ul style="list-style-type: none"> - Debris flows (Tjalling de Haas) - Estuary experiments (Jasper Leuven & Maarten Kleinhans) - TLS and Coastal Research (Marcel van Maarseveen & Gerben Ruesink) - Electronic & Mechanical Lab
	13:45	17:00	Committee meeting	
	17:00		End of site visit	

Appendix 4: Quantitative data

Utrecht University – IVAU

Table 5.2 Research staff at institutional and programme level

Institute level (IVAU)	2008		2009		2010		2011		2012		2013	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
Tenured staff	43	12,6	41	12,4	42	12,5	41	12,2	50	15,0	52	16,1
Non-tenured staff	37	21,4	39	22,1	52	32,4	48	30,1	44	25,4	52	27,8
PhD-candidates	78	52,9	74	50,3	70	43,0	70	50,6	83	59,2	82	57,4
Total research staff	158	86,9	154	84,8	164	87,9	159	93,0	177	99,6	186	101,3
Support staff	on average about 20 - 22 fte, of which 60-65% in the general geolab											
Visiting fellows	on average about 20-25 visitors at all times											
Programme 1: Dynamics of the solid Earth												
Tenured staff	21	7,0	21	7,0	20	6,6	19	6,5	28	8,9	28	9,6
Non-tenured staff	17	10,9	18	8,6	20	11,6	20	10,6	22	11,9	29	16,0
PhD-candidates	34	21,7	33	22,0	35	20,6	37	27,0	43	29,9	43	29,4
Total research staff	72	39,6	72	37,6	75	38,8	76	44,1	93	50,7	100	55,0
Programme 2: Climate and Environment												
Tenured staff	23	5,6	21	5,4	23	5,9	23	5,8	23	6,1	25	6,5
Non-tenured staff	20	10,5	22	13,5	33	20,8	29	19,5	23	13,5	23	11,7
PhD-candidates	44	31,2	41	28,3	35	22,4	33	23,6	40	29,4	39	28,0
Total research staff	87	47,3	84	47,2	91	49,1	85	48,9	86	48,9	87	46,3

Table 5.3 Main categories of research output at institutional and programme level

Institute level (IVAU)	2008	2009	2010	2011	2012	2013	total
Refereed articles	145	169	216	194	226	248	1198
Non-refereed articles	0	0	1	5	2	1	9
Books	2	0	0	2	2	1	7
Book chapters	17	13	5	19	12	5	71
PhD-theses	18	16	18	17	23	19	111
Conference papers	7	7	13	5	7	10	49
Professional publications	8	11	9	14	14	9	65
Publications aimed at the general public	4	12	16	10	41	68	151
Other research output	47	44	54	71	51	56	323
Total publications	248	272	332	337	378	417	1984
Dynamics of the solid Earth							
Refereed articles	58	61	92	72	99	104	486
Non-refereed articles	0	0	0	2	0	0	2
Books	1	0	0	2	2	1	6
Book chapters	5	6	4	8	4	2	29
PhD-theses	11	5	4	6	5	11	42
Conference papers	4	4	6	3	4	2	23

Professional publications	6	7	7	6	7	4	37
Publications aimed at the general public	3	2	7	4	6	29	51
Other research output	6	11	19	21	19	26	102
Total publications	94	96	139	124	146	179	778
Climate and Environment							
Refereed articles	94	112	132	126	132	150	746
Non-refereed articles	0	0	1	3	2	1	7
Books	1	0	0	0	1	0	2
Book chapters	12	8	1	11	8	3	43
PhD-theses	8	11	14	11	18	8	70
Conference papers	4	3	8	2	3	8	28
Professional publications	2	4	2	8	7	5	28
Publications aimed at the general public	1	10	9	9	35	40	104
Other research output	43	33	36	50	32	30	224
Total publications	165	181	203	220	238	245	1252

Table 5.4 Funding at institutional and programme level

Institute level (IVAU)	2008		2009		2010		2011		2012		2013	
<i>Funding (in fte):</i>	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Direct funding	21,0	24%	15,3	18%	14,1	16%	13,6	15%	14,7	15%	14,4	14%
Research grants	51,5	59%	50,6	60%	46,5	53%	53,2	57%	61,3	62%	63,3	63%
Contract research	14,4	17%	18,9	22%	27,3	31%	26,2	28%	23,6	24%	23,6	23%
Other												
Total funding	86,9	100%	84,8	100%	87,9	100%	93,0	100%	99,6	100%	101,3	100%
<i>Expenditure (in €):</i>	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Personnel costs	6.147	78%	6.210	79%	6.649	72%	6.675	59%	7.990	72%	8.367	74%
Other costs	1.776	22%	1.641	21%	2.626	28%	4.552	41%	3.077	28%	2.912	26%
Total costs	7.923	100%	7.851	100%	9.275	100%	11.227	100%	11.067	100%	11.279	100%
Research programmes	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
Dynamics of the solid Earth	39,6	46%	37,6	44%	38,8	44%	44,1	47%	50,7	51%	55,0	54%
Climate and Environment	47,3	54%	47,2	56%	49,1	56%	48,9	53%	48,9	49%	46,3	46%
Total funding (in fte)	86,9	100%	84,8	100%	87,9	100%	93,0	100%	99,6	100%	101,3	100%

Table 5.5 Standard PhD-Candidates

Enrolment of 'standard' PhD's				Success rates								Total					
Starting year	Enrolment			Graduated after								Total graduated		Not yet finished		Discontinued	
	M	F	Total	≤ 4 years		≤ 5 years		≤ 6 years		≤ 7 years		#	%	#	%	#	%
2005	4	9	13	0	0%	9	69%	10	77%	10	77%	10	77%	3	23%		0%
2006	8	10	18	0	0%	11	61%	14	78%	14	78%	14	78%	2	11%	2	11%
2007	8	3	11	1	9%	7	64%	9	82%	9	82%	9	82%	1	9%	1	9%
2008	6	5	11	0	0%	7	64%	7	64%			7	64%	3	27%	1	9%
2009	8	9	17	1	6%	10	59%	11	65%			11	65%	5	29%	1	6%

Table 5.6 Contract PhD-candidates

Enrolment of contract-PhD's				Success rates								Total					
Starting year	Enrolment			Graduated after								Total graduated		Not yet finished		Dis- continued	
	M	F	Total	≤ 4 years		≤ 5 years		≤ 6 years		≤ 7 years		#	%	#	%	#	%
				#	%	#	%	#	%	#	%	#	%	#	%	#	%
2005	0	0	0														
2006	2	0	2	0	0%	1	50%	2	100%	2	100%	2	100%		0%		0%
2007	1	0	1	0	0%	0	0%	1	100%	1	100%	1	100%		0%		0%
2008	1	0	1	0	0%	0	0%	1	100%			1	100%		0%		0%
2009	0	1	1	0	0%	1	100%					1	100%		0%		0%

Table 5.2 Research staff at institutional and programme level

Institute level (PGRI)	2008		2009		2010		2011		2012		2013	
	#	fte	#	fte	#	fte	#	fte	#	fte	#	fte
PGRI												
Tenured staff	23	7,5	26	8,4	24	7,8	25	7,7	25	8,3	26	8,1
Non-tenured staff	14	7,7	10	8,3	14	7,6	15	7,0	18	10,6	12	6,9
PhD-students	22	13,4	27	16,9	23	18,6	25	18,4	28	21,6	35	24,7
Total research staff	59	28,7	63	33,6	61	33,96	65	33,1	71	40,5	73	39,7
Programme 3: Coastal Dynamics, Fluvial Systems, and Global Change												
Tenured staff	12	4,3	14,0	4,8	14	4,6	15	4,6	15	5,1	16	4,9
Non-tenured staff	10	5,4	6,0	5,1	11	5,6	10	4,0	12	7,4	5	2,1
PhD-students	11	8,0	17,0	9,4	13	10,5	14	10,1	15	11,4	20	13,4
Total research staff	33	17,7	37,0	19,3	38	20,7	39	18,7	42	23,9	41	20,4
Programme 4: Landscape functioning, Geo-computation and Hydrology												
Tenured staff	11	3,2	12	3,6	10	3,2	10	3,1	10	3,2	10	3,2
Non-tenured staff	4	2,3	4	3,2	3	1,9	5	3,0	6	3,2	7	4,8
PhD-students	11	5,5	10	7,6	10	8,1	11	8,3	13	10,2	15	11,3
Total research staff	26	11,0	26	14,3	23	13,2	26	14,4	29	16,6	32	19,3

Table 5.3 Main categories of research output at institutional and programme level

Institute level (PGRI)	2008	2009	2010	2011	2012	2013	total
Refereed articles	74	62	72	88	94	107	496
Non-refereed articles	1	3	0	4	5	1	14
Books	4	1	2	2	1	2	12
Book chapters	22	8	1	5	6	3	45
PhD-theses	5	6	8	4	4	7	34
Conference papers	9	16	21	17	51	46	160
Professional publications	14	9	16	16	15	4	74
Publications aimed at the general public	3	5	12	4	12	12	48
Other research output	96	110	150	127	124	146	753
Total publications	228	220	282	267	312	328	1637
Programme 3: Coastal Dynamics, Fluvial Systems, and Global Change							
Refereed articles	42	35	42	44	54	56	273
Non-refereed articles	0	3	0	4	0	1	8
Books	1	0	1	1	1	1	5
Book chapters	9	3	1	2	4	2	21
PhD-theses	0	4	3	1	3	4	15
Conference papers	5	7	13	10	39	23	97
Professional publications	14	9	11	13	13	2	62
Publications aimed at the general public	3	5	8	3	3	5	27
Other research output	74	77	103	87	71	93	505
Total publications	148	143	182	165	188	187	1013

Programme 4: Landscape functioning, Geo-computation and Hydrology							
Refereed articles	33	38	31	54	43	58	257
Non-refereed articles	1	1	0	0	5	0	7
Books	3	1	1	1	0	1	7
Book chapters	13	5	0	3	1	1	23
PhD-theses	5	3	6	3	1	3	21
Conference papers	6	11	11	9	13	25	75
Professional publications	2	1	5	6	4	2	20
Publications aimed at the general public	1	0	4	1	9	7	22
Other research output	25	47	51	45	54	60	282
Total publications	89	107	109	122	130	157	714

Table 5.4 Funding at institutional and programme level

Institute level PGRI	2008		2009		2010		2011		2012		2013	
	fte	%	fte	%	fte	%	fte	%	fte / %	%	fte	%
Funding:												
Direct funding (1)	10,2	35,8	8,8	26,3	11,5	33,9	9,5	28,7	14,2	35	13,4	33,9
Research grants (2)	8,5	30,0	10,2	30,3	9,1	26,7	13,0	39,2	15,7	39	17,2	43,4
Contract research (3)	9,7	34,2	14,5	43,3	13,4	39,5	10,6	32,0	10,6	26	9,0	22,7
Other (4)	0,0		0,0		0,0		0,0		0,0		0,0	0
Total funding	28,4	100,0	33,6	100,0	34,0	100,0	33,0	100,0	40,5	100	39,6	100,0
Expenditure:	K€	%	K€	%	K€	%	K€	%	K€	%	K€	%
Personnel costs	2.299	93	2.887	93	2.933	93	3.165	93	3.139	93	3.394	93
Other costs	166	7	217	7	224	7	242	7	231	6	269	7
Total expenditure	2.465	100	3.105	100,0	3.157	100	3.407	100	€ 3.370	100	€ 3.663	100
Research programmes	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
CFG	17,7	62	19,3	57	20,7	61	18,6	54	23,9	59	20,3	51
LG&H	10,9	38	14,3	43	13,2	39	14,4	44	16,6	41	19,2	49
Total Funding	28,6	100	33,6	100	34,0	100	33,0	100	40,5	100	39,6	100

Table 5.5 Standard PhD-Candidates

Starting year	Enrollment (male / female)		Total (M+F)	Graduated after 4 years	Graduated after 5 years	Graduated after 6 years	Graduated after 7 years	Not yet finished	Discontinued
2005	6	1	7	1	2	1	0	2	1
2006	4	1	5	2	2	0	0	1	
2007	0	1	1		1				
2008	3	4	7	2	2	1		2	
2009	6	4	10	5	2			3	
2010	1	1	2	1	1				
2011	4	2	6						
2012	2	3	5						
2013	7	3	10						
Total	47	29	76	11	9	3		28	2

Table 5.6 Contract PhD-candidates

Starting year	Enrollment (male / female)		Total (M+F)	Graduated after 4 years	Graduated after 5 years	Graduated after 6 years	Graduated after 7 years	Not yet finished	Discontinued
2005									
2005									
2007									
2008	1	3	4	1	1			2	
2009									
2010	1	2	3	2				2	
2011	1	1	2	1				1	
2012	1	2	3					3	
2013	1	1	2					2	
Total	5	9	14	4	1			10	

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Table 5.2 *Research staff*

Institute level	2008	2009	2010	2011	2012	2013	Total
Full professors	2.29	2.37	2.31	2.22	1.99	2.30	
Associate professors	3.28	2.07	2.33	2.57	4.00	3.60	
Assistant professors	5.30	5.21	5.40	4.79	3.32	3.32	
Total tenured staff	10.87	9.65	10.04	9.58	9.31	9.22	58.67
Non-tenured staff	20.66	18.72	21.44	17.29	19.74	18.45	
Visiting fellows	0.41	0.77	0.37	2.47	6.38	3.75	
PhD candidates	27.80	28.31	25.20	30.59	25.97	23.75	
Total non-tenured staff	48.87	47.80	47.01	46.71	50.59	44.45	288.82
Total research time of research staff	59.74	57.45	57.05	58.11	60.65	54.42	347.42
Programme 1: Earth and climate							
Full professors	0.98	1.15	1.08	1.01	0.91	0.62	
Associate professors	1.88	1.12	1.52	1.52	2.24	1.84	
Assistant professors	1.52	1.22	1.75	1.88	1.80	1.80	
Total tenured staff	4.38	3.49	4.35	4.41	4.95	4.26	25.84
Non tenured staff	8.43	8.26	8.63	6.96	12.47	11.37	
Visiting fellows		0.60	0.10	0.38	5.63	3.00	
PhD students	4.25	4.43	6.50	10.13	16.39	15.47	
Total non tenured staff	12.68	13.29	15.23	17.47	34.49	29.84	123.07
Total research staff	17.06	16.78	19.58	21.88	39.44	34.10	148.84
Programme 2: Dynamic Earth and Natural Resources							
Full professors	0,83	0,87	0,84	0,82	0,64	0,64	
Associate professors	1,4	0,95	0,65	0,65	0,96	0,96	
Assistant professors	2,39	2,53	2,19	1,78	1,04	1,04	
Total tenured staff	4,62	4,35	3,68	3,25	2,64	2,64	21,18
Non tenured staff	6,28	5,49	6,26	5,5	1,09	0,9	
Visiting fellows	0,41	0,17	0,27	0,27	0	0	
PhD students	16,64	17,08	13,84	13,51	4,38	3,94	
Total non tenured staff	23,33	22,74	20,37	19,28	5,47	4,84	96,03
Total research staff	27,95	27,09	24,05	22,53	8,11	7,48	117,21
Programme 3: Deep Earth and Planetary Science							
Full professors	0,48	0,35	0,39	0,39	0,44	1,01	
Associate professors	0	0	0,16	0,4	0,8	0,8	
Assistant professors	1,39	1,46	1,46	1,13	0,48	0,48	
Total tenured staff	1,87	1,81	2,01	1,92	1,72	2,32	11,65
Non tenured staff	5,95	4,97	6,55	4,83	6,18	6,18	
PhD students	6,91	6,8	4,86	6,95	5,2	4,34	
Total non tenured staff	12,86	11,77	11,41	11,78	11,38	10,52	69,72
Total research staff	14,73	13,58	13,42	13,7	13,1	12,84	81,37

Note that the research equivalent for a full time professor is 30%, for an assistant and associate professor 40% and for PhD 75% and Postdoc 90% .

Table 5.3 *Main categories of research output*

Institute level	2008	2009	2010	2011	2012	2013	Total
Refereed articles	163	206	202	206	140	167	1084
Non-refereed articles	7	4	2	5	5	3	26
Book	2	4	3	1	0	0	10
Book chapters	13	10	31	20	18	15	107
PhD-theses	8	16	10	18	12	12	76
Conference papers	-	-	-	-	-	-	-
Professional publications	7	10	18	15	32	12	94
Publications aimed at general public	4	1	7	10	9	26	57
Other research output	11	2	22	15	12	32	94
Total publications	215	253	295	290	228	267	1548
Programme 1: Earth and Climate							
Refereed articles	81	106	104	96	71	88	546
Non-refereed articles	6	2	1	5	4	3	21
Books	2	0	2	1	0	0	5
Book chapters	12	3	26	10	6	8	65
PhD thesis	5	13	4	7	8	6	43
Conference papers	0	0	0	0	0	0	0
Professional publications	3	9	16	11	20	6	65
Publications aimed at the general public	1	1	0	10	1	1	14
Other research output	5	0	6	4	5	2	22
Total	115	134	159	144	115	114	781
Programme 2: Dynamic Earth and Natural Resources							
Refereed articles	47	66	58	67	43	53	334
<i>Tectonics</i>	21	28	29	15			
Non-refereed articles	1	1	0	0	0	0	2
Books	0	3	1	0	0	0	4
Book chapters	0	7	5	9	11	7	39
PhD thesis	3	2	5	7	1	3	21
<i>Tectonics</i>	2	1	3	4			
Conference papers	0	0	0	0	0	0	0
Professional publications	3	1	2	3	12	4	25
Publications aimed at the general public	0	0	0	0	1	5	6
Other research output	6	2	3	10	5	17	43
<i>Tectonics</i>	0	0	0	0			
Total	60	82	74	76	73	89	474
Programme 3: Deep Earth and Planetary Science							
Refereed articles	35	34	40	43	26	26	204
Non-refereed articles	0	1	1	0	1	0	3
Books	0	1	0	0	0	0	1
Book chapters	1	0	0	1	1	0	3
PhD thesis	0	1	1	4	3	3	12
Conference papers	0	0	0	0	0	0	0
Professional publications	1	0	0	1	0	2	4
Publications aimed at the general public	3	0	7	0	7	20	37
Other research output	0	0	13	1	2	13	29
Total	40	37	62	50	40	64	293

Table 5.4 *Funding of research capacity*

	2008		2009		2010		2011		2012		2013	
	K€	%	K€	%	K€	%	K€	%	K€	%	K€	%
Funding												
Direct funding	3.915	46,6	4.136	44,9	4.120	43,3	3.588	45,5	3.424	49,6	3.876	46,8
Research grants	3.506	41,8	3.573	38,8	3.677	38,6	2.561	32,5	2.457	35,6	2.790	33,7
Contract research	18	0,2	207	2,2	385	4	130	1,7	224	3,2	209	2,5
ISES	451	5,4	741	8,1	537	5,6	634	8	280	4	797	9,6
Other	506	6	547	5,9	803	8,4	965	12,2	519	7,5	617	7,5
Total funding	8.395	100	9.204	100	9.521	100	7.877	100	6.904	100	8.289	100
Expenditure	K€	%	K€	%	K€	%	K€	%	K€	%	K€	%
Personnel costs	6.869	78,4	6.837	74,9	7.275	78,6	6.733	76,6	5.642	78,2	6.524	80
Other costs	1.892	21,6	2.287	25,1	1.977	21,4	2.057	23,4	1.799	21,8	1.628	20
Total expenditure	8.760	100	9.123	100	9.252	100	8.790	100	7.441	100	8.151	100
Research programmes	fte	%	fte	%	fte	%	fte	%	fte	%	fte	%
1 – E&C	17,06	29	16,78	29	39,44	51	19,58	35	21,88	51	34,10	63
2 – DE&NR	27,95	47	27,09	47	24,05	31	22,53	40	8,11	19	7,48	14
3 – DE&PS	14,73	25	13,58	24	13,42	17	13,7	25	13,1	30	12,84	24
Total Funding	59,74	100	57,45	100	76,91	100	55,81	100	43,09	100	54,42	100

Table 5.5 *Standard PhD candidates*

Enrolment			Success rate								Total						
Start year	Enrolment male /female		Total male + female	Graduated after (≤) 4 years		Graduated after (≤) 5 years		Graduated after (≤) 6 years		Graduated after (≤) 7 years		Total Graduated		Not yet finished		Dis-continued	
	#M	#F		#	#	%	#	%	#	%	#	%	#	%	#	%	
2005	7	8	15	3	20	2	33	4	60	4	87	13	87	1	7	1	7
2006	6	5	11	2	18	6	73	2	91	-	91	10	91	-	-	1	9
2007	5	3	8	5	63	1	75	-	75	1	88	7	88	-	-	1	12
2008	3	2	5	1	20	2	60	1	80	-	80	4	80	1	20	-	-
2009	8	4	12	4	33	4	67	-	67	-	67	8	67	1	8	3	25
Total	29	22	51	15	29	15	59	7	73	5	82	42	82	3	6	6	12

Table 5.6 *Contract PhD candidates*

Enrolment			Success rate								Total						
Start year	Enrolment male/ female		Total male + female	Graduated after (≤) 4 years		Graduated after (≤) 5 years		Graduated after (≤) 6 years		Graduated after (≤) 7 years		Total Graduated		Not yet finished		Dis-continued	
	#M	#F		#	#	%	#	%	#	%	#	%	#	%	#	%	
2005	1	-	1	1	100	1	100	1	100	1	100	1	100	-	-	-	-
2006	2	-	2	1	50	1	50	2	100	2	100	2	100	-	-	-	-
2007	1	-	1	-	-	1	100	1	100	1	100	1	100	-	-	-	-
2008	2	-	2	2	100	2	100	2	100	2	100	2	100	-	-	-	-
2009	6	1	7	3	43	4	57	5	71	5	71	6	86	1	14	-	-
Total	12	1	13	7	54	9	69	11	85	11	85	12	92	1	8	-	-

Note 1: Contract PhD-candidates do not have employee status, receiving external funding or university scholarship, conducting research under the authority of the institutes with primary aim to graduate (beurspromovendus)

Note 2: Numbers in table 5.6 are uncertain because it is often unknown what the effective starting date of the PhD is (part of the work has sometimes been done before or substantially later than the official enrolment).