

RESEARCH REVIEW
EARTH SCIENCES
2014-2019

ONDERZOEKERIJ

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Preface

This review has examined the quality, productivity, impact and viability of Earth Sciences research over the past six years (2014-2019), at the Department of Earth Science and the Department of Physical Geography of Utrecht University and the Department of Earth Sciences of the Vrije Universiteit Amsterdam. The Review Committee consisted of Lena Merete Tallaksen, Rachel Mills, Kathy Cashman, Barbara Romanowicz and Gerard Govers.

Visiting other institutions with the aim to understand how they are trying to meet the research challenges they face and how they adapt to an ever-changing research landscape is one of the most rewarding tasks academics can do. Not only because you know that your advice is going to be taken seriously by your peers (after all, they asked for it), but also because it is a tremendous opportunity for the committee members to learn from those experiences and to reflect on what may be the better choices, the better organisation, the better research questions. Good research is not only a matter of questioning nature: it is also a matter of continuously questioning your peers and yourself on how things should be done and which things should be done. This visit, albeit virtual, was an excellent opportunity to do exactly this and the committee members have thoroughly enjoyed doing so.

Yes, the visit was virtual, but thanks to the collaboration of the departments we visited and an excellent preparation led by Dr. Annemarie Venemans, we were able to do our job very well (although we would have loved a nice dinner in Utrecht or Amsterdam with our Dutch colleagues). We had excellent presentations and discussions and the committee found the interaction with the members of the various departments very enjoyable. I also want to give special thanks to my fellow committee members here: It was a pleasure to work with such a committed and competent team and it was a very pleasant surprise to note that our opinions on the various matters we discussed converged very quickly.

We hope that our comments on each institute and programme will be useful for the departments we visited and that our comments may contribute to the further development of the already thriving field of Earth Science research in the Netherlands. That is, after all, our common goal. We hope that, through this report, we contribute to this, not as highly critical external reviewers but as critical colleagues who do not only try to provide useful suggestions, but also try to learn themselves.

Gerard Govers, Chair of the Evaluation Committee



1. Introduction

1.1 Terms of reference for the assessment

The quality assessment of research in Earth Sciences is carried out in the context of the Standard Evaluation Protocol For Public Research Organisations by the Association of Universities in The Netherlands (VSNU), the Netherlands Organisation for Scientific Research (NWO), and the Royal Netherlands Academy of Arts and Sciences (KNAW).

The committee was asked to assess the scientific quality and the relevance and utility to society of the research conducted by three institutes of two universities in the reference period 2014-2019, as well as its strategic targets and the extent to which it is equipped to achieve them.

Accordingly, three main criteria are considered in the assessment: research quality, relevance to society, and viability. In addition, the assessment considers three further aspects: the PhD training programme, research integrity and diversity.

This report describes findings, conclusions and recommendations of this external assessment of the research in Earth Sciences.

1.2 The review committee

The Board of the two participating universities appointed the following members of the committee for the research review:

- Prof. Gerard Govers, KU Leuven
- Prof. Barbara Romanowicz, Collège de France, Paris, University of California, Berkeley
- Prof. Katharine Cashman, University of Bristol
- Prof. Lena M. Tallaksen, University of Oslo
- Prof. Rachel Mills, University of Southampton

The Board of the participating universities appointed dr. Annemarie Venemans of De Onderzoekerij as the committee secretary. All members of the committee signed a declaration and disclosure form to ensure that the committee members made their judgements without bias, personal preference or personal interest, and that the judgment was made without undue influence from the institutes or stakeholders.

1.3 Procedures and scope

This visitation concerns the Department of Earth Sciences of Utrecht University (DES), the Department of Physical Geography of Utrecht University (DPG) and the Department of Earth Sciences of the VU University, Amsterdam (VU-ES). Clearly, this visitation does not include all Dutch institutes involved in Earth Science research; in the Netherlands, eleven universities have activities in the broader field of Earth and Environmental Sciences. Thus, this evaluation cannot provide a full picture of the Dutch Earth Sciences landscape, nor can it contrast the culture and results of the departments within the scope of this review with all relevant research departments in the Netherlands. The committee does not consider this to be a major problem. Indeed, the assessment does not aim to benchmark Earth Sciences



departments relative to each other. Rather it aims to give an assessment of the scientific quality and the relevance and utility to society of the research conducted, as well as its strategic targets and the extent to which it is equipped to achieve them. The committee believes that by doing so departments get a fair assessment. A broad overview of the current state of Earth and Environmental Sciences research can be found in the section '*Richting een veilige en duurzame samenleving – Beeld van de Nederlandse Aard- en Milieuwetenschappen*' in the report '*Sectorbeelden Betawetenschappen 2020*' (in Dutch) that was recently published.

The committee was obliged to make this assessment through on-line meetings and interviews, given the Covid-19 pandemic restrictions. Whilst this evidently had an impact on the interaction between the committee and the various groups the committee interviewed, we do believe that we were able to get a good insight in the way the departments operate, not only with respect to the assessment criteria, but also with respect to the broader culture in the various departments. Nevertheless, it is obvious that a remote assessment is an emergency solution: a physical visit most certainly would have allowed a more lively and direct interaction and would have allowed the visitation committee to directly experience the physical environment (offices, laboratory infrastructure) in which the various departments operate. A place visit should therefore remain part of the standard procedure and remote evaluation should be considered only as a possible fall-back.

The committee members studied in detail the self-evaluation reports in the weeks before the site visits and prepared a preliminary evaluation along with a series of considerations and potential questions. The committee had a preparatory meeting, led by Annemarie Venemans (De Onderzoekerij) on November 11, 2020, where questions and considerations were discussed and where the necessary practical arrangements were made. Virtual visits took place on November 12 in the morning (DES, Utrecht) and afternoon (DPG, Utrecht) and November 13 in the morning (VU-ES). Following these online meetings, the committee made an overall preliminary evaluation that was reported back to the departments on November 13 in the afternoon.

The self-evaluation reports written by the three departments and made available prior to the site visits, provided important and relevant information of immense help in the assessment. Despite the fact that the main elements of the report are prescribed there are clear differences in the way departments present themselves: this provided the committee with valuable information on the specific characteristics of each department. Below, the committee formulates its general observations and remarks on the various issues the committee was asked to consider.



2. General observations and recommendations

2.1 Quality of research

The overall quality of Earth Sciences in the Netherlands is high. According to the recently published *Sectorrapport*, the academic institutions in the Netherlands produce ca. 12% of all EU-publications in these domains and these publications receive 14% of the citations towards top 1% publications in the EU. The #1 Times Higher Education ranking for environmental awareness in 2016 (based on their output between 2011 and 2015) is a mark of esteem and impact that is particularly notable, and related directly to bibliometric citations of outputs from a coherent research programme over a 5-year period. Here Utrecht University is ranked highest, however, the numbers reflect not only on DES and DPG, but on the environmental science research produced by the whole University.

The committee is of the opinion that all three departments that it visited have a very strong publication output and strongly contribute to the remarkable position of the Netherlands in the global Earth Sciences field. One of the striking facts is that all visited departments have a significant production of papers in highly visible journals such as *Science*, *Nature* and *PNAS*. While it is true that there is no one-on-one relationship between highly visible research and high-quality research, these papers do illustrate that the three departments produce research that is strongly valued within the international scientific community. Clearly, such high impact publications are only possible in departments with a true research culture where scientists feel that they have the liberty to pursue potentially ground breaking, high-risk projects. Maintaining this culture is, according to the committee, essential for the further successful development of Earth Sciences in the departments assessed as well as in the wider science community. It is therefore a task of major importance, both for university management and for those responsible for research funding at the national level, to maintain and further develop this strong research culture.

2.3 Societal relevance

The committee observed a deep awareness of the importance of societal relevance in all three departments and the departments are to be commended for that. However, it is also clear that there are important differences in the way the departments address societal relevance and some departments have evolved further than others. DPG has appointed one of the senior staff members as the impact coordinator and has implemented a monitoring strategy. This is clearly an effective way to make sure that societal relevance remains high on the agenda so that no opportunities are missed and the department can fully play its role as a provider of knowledge and in engaging young people in the Earth Sciences.

All three departments refer to sustainability as a key topic (and rightfully so). However, it is not clear yet how and to what extent sustainability has become truly embedded in the vision of the departments and how this rather broad concept has been incorporated in specific research objectives. The committee considers it to be essential that the departments make a deliberate effort to translate sustainability concepts into their research strategy and teaching. The latter is particularly important in terms of relevance and in recruiting students. It is important that the early career staff members are fully involved in this debate as they are the key contributors to the research in this domain, today and in the future.

Similarly, much of the mission-oriented research carried out by the different departments can only be successful if there is a productive collaboration with social scientists (economists, social geographers, planners, sociologists...). While it is clear from the conversations the committee had that there is such



collaboration in specific research projects, there is still little mention of such collaboration in the research visions put forward by the individual departments. The committee encourages each department to reflect more explicitly on this point and to better integrate collaboration with social scientists in future research visions and in some, but not all, research initiatives so as not to undermine fundamental research efforts in the Earth Sciences.

Discussions on societally relevant issues should, evidently, transgress the research groups in each of the departments. Here, discussion platforms across group boundaries at all levels, from the most junior to senior academic staff members are encouraged. While the committee is convinced that such inter-group discussions already are taking place, it is recommended that these discussions would benefit from being organised in a structural way. This will lead to an even better interaction between the different research groups and will help to eliminate the last remnants of what might be called ‘group silos’, where members of a specific research group are too dependent on their group leader as a gateway for information. Formalising these structures will ensure that discussions transgressing the scope of the individual research group occur regularly and will help develop the next generation of research leaders who are comfortable working at disciplinary boundaries on topics with societal impact.

2.4 Viability

The committee experienced in all three departments that the recently appointed researchers (tenure track professors as well as postdocs and PhD researchers) were very enthusiastic and highly motivated. While this does not guarantee viability from a financial point of view, the committee nevertheless considers a pipeline of future research leadership talent to be of vital importance for the development of Earth Science in the Netherlands. No scientific effort can be successful if those participating are not dedicated and consider the science that they are doing as purposeful and relevant.

The three departments are all heavily dependent on state-of-the-art laboratory equipment. It is important that decision makers realise that outstanding research in the Earth Sciences requires access to such equipment. The committee is convinced that the faculties to which the departments belong are aware of this necessity and provide both infrastructure and laboratory space that are sufficient for the research groups to thrive. Universities hosting these departments should be clear on this. At present, there are clear differences in the way field equipment and laboratories are managed within the three departments: DPG and DES have pooled their lab infrastructure while at VU-ES the individual research groups appear to be responsible for their own facilities operations and equipment. Furthermore, concern about laboratory space makes some researchers at VU-ES question the future viability of their research. While there may not be one ideal system for lab management (we would all have discovered it a long time ago if it did exist), the committee recommends that there is at least a minimum co-ordination at the department level with respect to laboratory equipment, availability and priority use. Not only is this necessary to make sure that more recently appointed staff members have access to the equipment they need, but it is also of vital importance when strategic decisions are taken or proposals have to be defended.

The committee discussed extensively the shift in the funding landscape that has taken place over the last decade(s) in the Netherlands as in many other countries, whereby mission-oriented research has become much more important. The committee agrees that mission-oriented research has an important place in Earth Sciences. After all, one cannot maintain that Earth Sciences disciplines are important and relevant to society if no effort is made to transfer and apply the knowledge gained. However, knowledge and technology transfer can only continue if there is sufficient funding and resources available for fundamental, blue-sky research. Also, some of the scientifically most fascinating fields in Earth Sciences research do not necessarily have an immediate application. At present, the departments



the committee visited do not experience significant tension between the need for fundamental research and the societal demand for applications. However, the committee recommends that, at the national level, sufficient attention is given to the funding of fundamental research in the Netherlands. This requires a continued debate so that the right balance can be found whereby departments can, at the same time, continue their fundamental research programmes and play an important role in the application of Earth Science for a better and more sustainable society. The recently published *Sectorrapport* for the Earth and Environmental sciences is an excellent starting point for such a debate.

A final consideration: Viability is not only a question of financial sustainability. Viability also depends on departmental culture and vision. The committee believes that all three departments have an open, stimulating research culture, although there is room for improvement in some areas. This culture could be reinforced by formulating a set of common research questions and common research goals for each department. The committee believes such an exercise will lead to a shared vision that is widely understood by all department staff members. This will not only help the departments to focus on what is truly important in their respective fields, but it will also help making the department more resilient in times of limited resource allocation in the field of Earth Sciences. The committee also found it striking that comments on a high workload (which may be a threat for long-term viability) were more frequent in those groups where organisation was still a bit more ‘vertical’, i.e. where individual research groups were acting more independently rather than being strongly interconnected. The committee is of the opinion that this is a further reason to strive towards an integrated departmental organisation that allows to balance temporal shifts in workload and allows to easily identify overlaps where teaching and/or technical work can be organised more efficiently. The support of a highly qualified department manager can be of key importance here.

2.5 PhD programme

The committee strongly appreciated that the doctoral researchers in all departments explicitly stated that they had a healthy work-life balance. The management of all three departments is to be commended for this. It reflects a strong engagement of the management with the well-being of all staff members and doctoral researchers in particular.

The committee is of the opinion that the PhD programmes in the three departments are strong and vibrant: the PhD researchers clearly feel ‘at home’ in their departments. While there are some small differences, the committee is of the opinion that all departments have good systems in place to monitor progress so that interventions can be made when problems arise. The committee is very positive about the fact that each PhD student has two supervisors. The committee believes that a generalisation of this principle could be beneficial for both the well-being and the scientific productivity of PhD researchers.

In some departments the PhD researchers could benefit from a more formal interaction with the management and stronger interactions with PhD researchers from other research groups within, as well as across, departments. The committee is of the opinion that such a formal discussion/interaction platform would not only strengthen the PhD community and provide a voice for their concerns, but would also benefit the research in each department as it would promote cross linkages and help to develop new ideas for collaboration.

One particular concern is that of PhD duration. There is a considerable fraction of PhD researchers in all three departments that need significantly more time than 4 years (the standard period that is foreseen in the Netherlands) to complete, with a significant fraction of PhD students needing more than 5 years. This is something that needs to be monitored and measures should be put in place to minimise this problem.



2.6 Research Integrity

The committee is of the opinion that all three departments have developed a strong culture of research ethics which is supported by mandatory courses for researchers and codes of conduct at the university and/or at the national level. All institutions have also set up procedures that allow to researchers to come forward with potential problems so that they can be addressed. The committee does not have further general reflections nor general recommendations on this topic.

2.7 Diversity

The committee feels that there is a good balance between Dutch and international staff and that international staff members feel welcome and are well integrated in their departments. This is very positive and the liberal use of English as the 'lingua franca' in research and academic education in the Netherlands is definitely a major factor here. The committee encourages the departments to continue their efforts to welcome both international and Dutch PhD students (and postdocs) and to create a stimulating working environment for all.

While there has been consistent positive progress towards a more equitable gender balance, the departments are encouraged to take further initiatives to improve the gender balance of their academic staff. Every academic staff hire is an individual process, which makes it difficult to monitor and maintain a balance at this point, but further improvement is certainly possible on a more general level, e.g. by identifying potential female candidates and explicitly inviting them to apply and by making sure that the vocabulary used in vacancy texts and in communication in general is gender neutral. It is also important to ensure a good gender balance at all levels in the organisations where important decisions are taken. The committee was only provided data on gender-based diversity and cannot comment on any other important characteristics that will no doubt also be crucial in the future for development of a truly diverse and talented workforce.

2.8 One final remark

The committee has thoroughly enjoyed the intense interaction with the management and the researchers of all three departments and has once more experienced the wide range of research sub-disciplines that are a characteristic of the Earth Sciences. This variety in disciplines and interdisciplinary knowledge is both an asset and a potential risk. An asset - as the range of disciplinary knowledge allows the departments to respond to a wide range of new, societal needs as they emerge, needs that require an interdisciplinary approach. A challenge – as the departments must maintain focus on important common goals while at the same time ensuring individual needs and disciplinary objectives and, where it already exists, make sure that this sense of common purpose is maintained and even strengthened. One way to do this may indeed be to organise debates on the big scientific questions that can only be answered through joint efforts. Such debates will also help to keep excellent science central to the departmental culture and experience; good science remains, after all, your (and our) lifeblood.



3. Department of Earth Sciences, Utrecht University

3.1 Quantitative assessment

The committee assessed the quality, societal relevance and viability of the Department of Earth Sciences (DES) of Utrecht University both quantitatively and qualitatively. Its PhD programme, research integrity and diversity are assessed qualitatively. For the quantitative assessment a four-point scale is used, according to the standard evaluation protocol 2015-2021. The explanation of the criteria underlying the scores can be found in appendix C. The qualitative assessment of the Institute can be found in the next sections.

Given the standards laid down in the SEP, the committee has awarded the following scores to the department:

Research quality:	1
Relevance to society:	2
Viability:	1

3.2 Organisation, strategy and targets

DES has a clear ambition to be a world-leading centre of excellence in scientific research as well as research training, to acquire new and fundamental geoscientific knowledge and directly address societal challenges related to the field of Earth Sciences.

The department has successfully addressed issues raised during the previous review period, including implementation of a merger of two research programmes (solid earth and climate) into a single earth science programme with the goal of achieving better communication and multi-disciplinary integration. This integration has also been facilitated and accelerated by a remarkably smooth move to a new building and the resulting proximity of the Faculty and researchers within it, and by and extensive hiring of new staff working at the interface of disciplinary boundaries.

The DES strategy is to hire the best quality staff from around the world and coach/support these staff on appointment to ensure they thrive, and to give them the freedom to develop their own programmes. DES has made excellent faculty hires (17 fte) over the review period and now are in a period of consolidation without any intent to grow further. A notable step towards multi-disciplinarity across the department has been the appointments of chairs to establish stronger links between paleoclimate research and geodynamics, and to link seismology, mantle dynamics and geomagnetism. Collaborations have also been reinforced across classical fields of geochemistry, hydrogeology, structural geology and mineralogy.

DES needs to be ready for agile response to a rapidly changing funding environment with more emphasis on applied research. The leadership team are well aware of this imperative and have set targets around generation of diverse external funding, diversification of staff and PhD student communities and valorisation of research impact.

The research themes across DES are defined by the interests of the staff and their funding success. The very flat management structure and absence of strong hierarchy in DES, in contrast to more traditional structures in some academic institutions, works remarkably well and empowers the faculty to understand their roles and responsibilities clearly and have the freedom to define their own research programmes within the broad range of Earth Sciences. There is clear ambition to influence government



and wider policy and generate impact for society and there are emerging plans to deliver this in the future. The mechanisms used to align individual PI effort collectively to address overarching societal priority goals such as sustainability and other trans-disciplinary efforts with e.g., social scientists, were not particularly clear to the review committee.

The impact of Covid-19 on the research activity was apparent in all areas, but there was a refreshing positivity about minimization of this impact over the next period. Staff had access to key research facilities and were making good progress despite limitations of access to buildings and lack of normal departmental activity.

The flat management structure and good communication in DES, coupled with a healthy work-life balance at all levels in the Department, are strengths of the organisation that permeate all areas and lead to a strong research environment where staff and PhD students thrive. New appointments have progressed quickly to senior levels and cite the support, clear promotion structure and clarity of information as enablers in their progression.

The new merit promotion process being piloted at the University of Utrecht (DES and DPG) adds outreach/valorisation activities as one of the criteria for evaluation. It is very much welcomed by the younger staff and the more senior staff alike and promises to be a useful innovation for diversifying further the staff profiles, recognizing their diverse contributions, and enabling reward and progression for a wider range of talent. This new initiative should be reviewed at the earliest possible point to evaluate the success and further develop the programme.

The Department places particular emphasis on good work-life balance and role models this from the top. Staff and PhD students all appreciated the attempts to balance out priorities, particularly during the Covid-19 pandemic period. There is an ambition to generate enough funding headroom to provide sabbatical leave to staff and enhance productivity through opportunity for focused progress on their research. For those with extensive and well-funded research programmes, a need for additional support to partly cover their teaching duties was articulated by some senior staff.

3.3 Research quality

Research at DES covers a broad range of scientifically relevant and original research topics, encompassing frontier research on the present state and evolution of all parts of the Earth system (from solid earth to its fluid envelopes) and their interactions, with an emphasis on inter-disciplinarity. DES is recognised as an international leader in many of the core earth-science disciplines and engages in timely and important research topics.

The output indicators provided to the review committee are outstanding, generating significant citations or other types of metrics and demonstrating impact on the community. Some of the outputs provided illustrate the quality of the staff hired during the review period, others the high quality of PhD student projects and results, while others confirm the sustained excellent performance of established members of DES staff. The quality and quantity of publications and other products puts UU-ES at the top of the discipline internationally.

Research output rate is high with ~14 peer reviewed papers per faculty (scientific staff) fte per year, respectively 2.5 papers per total research staff fte per year (Appendix B.1), with a significant proportion published in top ranked journals. Many of these outputs have a high level of citations (notably in sediment-related research, and impact in environmental science research). The metrics provided assure the review committee that the quality, productivity, impact and relevance have been consistently maintained across the review period. Of particular note is the quantity and quality of the PhD graduates



from DES, their outputs and career trajectories, this is a real measure of the quality of the programme (see section 3.6). In addition, there are many other marks of recognition by peers nationally and internationally (medals, fellowships, advisory boards).

External funding is very healthy, with remarkable success at very competitive programmes such as the ERC. The growth in postdoctoral fte during the review period demonstrates success with competitively won funding and is a measure of the quality of the research programme. The recent drop in ERC funding is noted, but is compensated by a pipeline of imminent new awards that show promises for successful future research grants.

DES members are leading national inter-university initiatives such as NESSC, the Origins Center, EPOS NL and DeepNL. DES is also well connected internationally, with major roles in IODP, and partnership in the Geo.8-European Network for Earth Sciences initiative. Metrics for staff, leadership team and outputs are all strong and benchmark well against top institutions in Europe.

There is no evidence that the disruption from the move to the new building and inevitable delays in e.g. high-performance computing has had noticeable impact on the metrics presented or the promise of future excellent outputs.

3.4 Societal relevance

DES members are acutely aware of the potential societal relevance of their basic research, providing a long-term perspective to such societal issues as natural hazards, water management or climate change, amongst others. Staff and PhD students carry out an impressive range of high impact dissemination and engagement activities. These activities target areas that are emerging areas of societal relevance and aligned to areas of quality research activity in DES. This outreach not only enhances the impact of the research at UU-ES, but it also builds the Earth Sciences discipline and its popularity with potential undergraduate and postgraduate students, essential for the health of the Department and wider society.

The demonstrable increase in participation of societally relevant stakeholders from 23% to 43% in funded PhD and postdoctoral projects demonstrates progress towards societally relevant activity over the review period. Staff provided several examples of exciting funded projects that related their high-quality research activity to relevant solutions for society.

DES staff contribute towards the UU strategic theme "Sustainability", though it was noted that the early leadership of this theme has somewhat dissipated and there are fewer connections with the more social science focus of the theme in recent years. There are opportunities to drive forward connections via this theme and engage in societally relevant research through collaboration with other disciplines.

That said, the committee did not find a clearly articulated 'societal relevance strategy' and whilst there is a long list of activities undertaken, it is not clear how this is co-ordinated, nor how activity is prioritised across DES. The relative balance of media activity, versus school visits, versus policy engagement, does not appear to be strategic and the committee recommends some prioritisation and focus in the upcoming period. The number of interactions is recorded, but the impact thereof is harder to evaluate and the Department is at the early stages of coordinating their societally relevance work in a strategic way.

The committee notes that DES does have a newly established (2018) Impact Committee that is working on identifying key societal issues addressed by research in DES and how to increase impact on policy and public engagement. This committee is populated by a range of new professorial hires and early career staff and works closely with the Faculty's communication and marketing department. The work



of this committee to coordinate activity across the department and prioritise the most effective mechanisms for delivery of impact has been disrupted by Covid-19 and progress in this area is a priority for the next phase of DES delivery.

Overall, the committee's assessment is that there is enthusiasm for engagement and delivery of societally relevant research, particularly amongst the newer hires in the department. What is lacking is a clear strategy and action plan for activity over the next period to put DES in the strongest position for acquisition of new funding in a rapidly shifting external environment.

3.5 Viability

DES delivers a single research programme via a flat internal structure reflecting the bottom-up strategy of hiring excellence and allowing individuals to thrive and deliver. The mission is ambitious and all-encompassing in terms of scales of space and time. The strengths in core science are apparent and working together, they deliver an excellent quality, and societally relevant research programme that can solve urgent societal problems. This approach puts them in a good position for future viability.

Self-reflection and benchmarking against top institutions informs the DES decision to focus on postdoctoral support and career progression to develop a pipeline of talent and top research outputs, whilst at the same time, closing the diversity gap in the organisation.

Having expanded the breadth of expertise in the last decade, there is no intention to grow further or change size/shape in the future, an important strategic move towards long term financial viability. The future hiring strategy is to open new faculty positions when positions are freed up through retirement, after open consultation about the target profile and level of the new role. There is a strong commitment to excellence in hires and an eye on filling gaps in expertise/succession planning, diversity and integration across the subdisciplines, which has been enabled by recent restructures.

DES has invested heavily in critical state-of-the-art equipment (e.g. supercomputers, analytical instrumentation), which are now installed in the new buildings. The facilities are run by scientific user committees that address long-term planning, needs and organisation of proposals for funding the desired equipment, mostly acquired through external funds. This approach ensures the success of the Department mission.

DES has shifted the balance of funding to maintain a 1/5 ratio (or better) between direct funding and grants/contracts and 90% of salaries of permanent staff are covered by direct funding. The funding portfolio is diverse and there are large contracts from ERC, which DES has been able to win periodically with a healthy funding portfolio through to 2025. In the future, they plan an increased effort towards securing society-oriented programmes (hazards, climate change) within the new EU Horizon Europe programme.

The external linkages via collaboration and connection with the rest of the Netherlands research landscape are well articulated, but the internal UU connectivity is less clear. There is a strengthened connection with DPG and other departments in the Faculty via co-location. These cross-University, cross-disciplinary opportunities need to be further deepened to deliver societally relevant research with impact.

The DES culture and quality of individuals puts them in a great place for responding in an agile way to the shifting funding landscape, through the collaborative consortium approach to future programmes. By introducing outreach/valorisation (2020) as part of their internal evaluations for promotions, they have taken steps towards better connecting with the public and society.



There is a clear succession plan for the senior management with the next head of DES already identified along with the Director of Research. Succession planning appears to be well coordinated and with time, the senior management team will become more diverse (see 3.8). The review panel encourages open and honest reflection on the weaknesses and risks identified for DES during this transition to new leadership.

3.6 PhD programme

The PhD programme is healthy, well-funded, and with a good balance of national and international candidates. The department has on average 2.7 PhD students per research faculty fte (Appendix B.1). There are ~4-5 PhD completions per faculty research fte in the review period, and additional contributions to PhD theses led at other institutions. PhD theses are of high quality, with the practice of being built on chapters that are either already published in refereed journals, or prepared to be so, and the involvement of an international examination committee provides continued assurance of this quality.

There is in general a small proportion of non-completion (~9 %), though the completion rate within the 4 years of funding is lower than expected for a world class institution (only 3%), whereas about 60% has completed within 5 years. This slow completion appears to be a function of candidates starting employment after 4 years and continuing in the margins of their time to completion. The practice of appointing at least two advisors for each PhD student, who meet with the candidates regularly to provide supervision and direction, evaluation during the first probationary year and career orientation resources, are to be commended.

In the review period, DES has moved to new facilities with excellent infrastructure, which allows new linkages with other parts of UU and a more integrated PhD programme. These moves must have impacted productivity for a period, as has the ongoing Covid-19 pandemic, but the overall improvement in the working environment and contiguous space provides promise to significantly enhance the PhD programme. Even students that had started PhD work during lockdown reported satisfaction with arrangements and good progress with project work with appropriate adjustments put in place for prioritisation and extensions of programmes.

An important new feature is the bi-weekly Friday Earth Science Talks that improves communication and awareness across different sub-disciplines, which in particular serves to broaden students' horizons.

Another worthy observation is the increased proportion of engagement of societal partners in the PhD and postdoc projects at DES which increased from 23% to 38% in the current review period and is still increasing.

There are two issues of concern: the completion rate and perceived pressures at outset of projects in some areas. The committee recommends improving the induction process and early mentoring to ensure progression at pace to complete within the 4 years of funding.

3.7 Research integrity

No research integrity issue was identified in DES during the review period and resources are available at UU for research integrity training. The non-hierarchical organisation of DES and resulting excellent lines of communication help ensure day to day research integrity and safeguarding against manipulation of data. There is a clear Code of Conduct, adoption of good practice from elsewhere in the sector and established procedures within Utrecht University for reporting issues.



All PhD students undertake a mandatory research integrity course as part of their development and no research integrity breaches or other issues were apparent during the review period.

3.8 Diversity

DES has significantly improved the faculty gender balance in the last 10 years, from 7% female staff in 2008 to 33% in 2019, noting that among the 17 new hires in the last 6 years, 9 are female. While reductions in the female proportions in the PhD and Postdoctoral staff were noted, these pools are much more variable year on year and, for example, this year's intake of PhD students was 72% female. Overall, the percentage of female scientists (33-40%) is stable over the last 6 years, which compares well to similar institutions internationally. The age profile and balance between national and international staff is healthy and appropriate.

Notably, DES hired two female post-doctoral researchers internally on tenure-track faculty positions. They were able to search specifically for female candidates for a senior faculty position in hydrogeology, which resulted in 1 full time hire at assistant professor level and one part time full professor. There is additional targeted support for female staff through the career scheme to coach, mentor and progress talented women in UU, which is welcomed by those involved.

The merit promotion pilot at UU promises to be transformative for diversity of progression and ultimately attraction of staff to the University. This initiative should be monitored closely, promoted widely in recruitment materials and shared as best practice across the sector if it can be demonstrated to shift diversity at pace.

3.9 Recommendations

- Continue the strategy of maintaining the current staff numbers achieved through significant expansion during the previous review period and extension of the breadth of expertise during the current review period. Consolidation is now critical for long term financial viability;
- Develop ways to set aside support for partial teaching release for faculty with extensive and externally well-funded research programmes;
- Resume and step-up the work of the "Impact Committee", disrupted by Covid-19, to articulate the Societal relevance strategy, coordinate activity across the department including engaging with more senior established staff in the department and prioritise the most effective mechanisms for delivery of impact. Progress in this area is a priority for the next phase of DES delivery.
- The new merit promotion process, which adds outreach/valorisation activities as one of the criteria considered for evaluation, should be reviewed at the earliest possible time to gauge its success and further adjust as appropriate.
- Work at improving the induction process and early mentoring of PhD students in order to increase their awareness of expectations, with the hope of improving completion rates and relieve pressures at the time of thesis completion.
- Further deepen cross-University, cross-disciplinary collaboration to deliver societally relevant research with impact. There are opportunities to drive forward such connections via the Sustainability theme.



4. Department of Physical Geography, Utrecht University

4.1 Quantitative assessment

The committee assessed the quality, societal relevance and viability of the Department of Physical Geography of Utrecht University both quantitatively and qualitatively. Its PhD programme, research integrity and diversity are assessed qualitatively. For the quantitative assessment a four-point scale is used, according to the standard evaluation protocol 2015-2021. The explanation of the criteria underlying the scores can be found in appendix C. The qualitative assessment of the Institute can be found in the next sections.

Given the standards laid down in the SEP, the Committee has awarded the following scores to the department:

Research quality:	1
Relevance to society:	1
Viability:	1

4.2 Organisation, strategy and targets

The mission of the Department of Physical Geography (DPG) is to be at the forefront of research in Earth Surface Dynamics globally (Earth's continental and coastal systems), providing research of high quality and societal relevance. DPG highlights its activities and achievements in the following five fields: global hydrology, mountain hydrology, deltas, coastal and river research, all key dynamic elements of the Earth (surface) system. The research is directed to the understanding of the physical processes, patterns and forms at the Earth's terrestrial surface and their interactions as well as their relation to biotic factors and human interference. Focus is on the river basin as a unit, separating between four distinct zones within the basin, and the combination of fieldwork, modelling and experiments are key for all fields.

Following the former evaluation, two programmes were merged into the programme Earth Surface Dynamics, and structured into six research lines. Researchers from varying disciplines contribute to each of these. This has – according to the department - enhanced research synergy and led to establishment of a range of new research venues, most of which falls within the five fields highlighted. This is also reflected in more joint publications. Moving to a new building further enhanced collaboration within the department, which previously was scattered over the campus. Also, the building itself stimulates more informal meetings and people find each other across traditionally disciplinary boundaries. This has resulted in many new - and interdisciplinary - research proposals, addressing topics that connect well to society.

The move also involved merging the laboratories of DPG and DES, which was a major task and caused some delays. However, the new Earth Simulation Laboratory offers excellent facilities close to the department and stimulates new collaboration. The merge is now viewed very positively, as is the participation in a joint in-house high performance (HP) facility with DES, offering support for HP computing and data science. The establishment of a position within scientific modelling further supports this effort. Maintenance and support of physical research facilities (lab and field equipment) and



software, models and data, depend partly on soft funding, which makes opportunities for continuous support a matter of concern.

In addition to the strengthened connection with DES in the reviewing period, which was already good (e.g., joint bachelor and master), the move has led to increased collaboration with other departments in the Faculty through the co-location, notably the Department of Sustainable development and Human geography. The committee believes that these are very positive developments and that specifically the collaborations with social scientists from relevant disciplines, could be further strengthened and made more visible.

Overall, the reorganisation of the department and the move to more modern facilities appear to be a positive development, releasing the research potential within the group. It is a very dynamic department, with clear ambitions. DPG has been successful in increasing funding since the last evaluation (external funding rate of 65%) and in hiring more people. The successful hiring of talented young and early-mid career scientists has been targeted towards excellence and interdisciplinarity. The funding portfolio is diverse, including prestigious grants from NWO (Veni, Vidi, Vici) and EU (ERC), and contract research from ministries and companies. The high percentage of external funding makes the department vulnerable to shifting research agendas of the funding organisations, and places continuous high pressure on the staff to bring in their own salaries (~80% of salaries are covered by direct funding) and research support funding. The new hiring will likely contribute additional funding in the longer term, as DPG is focusing on consolidation and not further growth, an approach that is supported by the committee.

DPG has not formulated any specific overarching research questions that could act to bind the department together and better communicate the research profile of the department to the outside world. However, the scientific profile of the department is rather coherent and the loose structure allows new ideas to develop. How to find the best balance between a 'free' bottom-up research approach (also in the choice of subjects) versus having a clear strategy formulated around key research questions and research areas, requires continuous evaluation from the management. Furthermore, organising a department-wide reflection on this would have benefits, if only because it would allow integrating the efforts of the different research groups of the department even better.

DPG has made some important, and successful, strategic decisions since last review (such as the merger of the laboratories and the research programmes) and overall gives an impression of a successful organisation that makes informed decisions. The future strategy will continue along current research lines and methodological approach (combining experimental field/lab and model-based methods). The strategy outlines three new emerging fields that align with the current research focus and capitalising on the expertise within the group. These are data sciences, integration of human factors, and environmental impacts on health, which all are timely and well argued, and further supported by management decisions (ref. the launch of a new tenure track on extreme environments and within data sciences).

The new merit promotion process being piloted by the Faculty adds outreach/valorisation activities as one of the criteria for evaluation. It is welcomed by the younger staff and the more senior staff alike and promises to be a useful innovation for diversifying further the staff profiles, recognizing their diverse contributions, and enabling reward and progression for a wider range of talent. This new initiative should be reviewed at the earliest possible point to evaluate the success and further develop the promotion programme.

The impact of Covid-19 on the research activity was apparent in all groups, affecting fieldwork and lab access in particular. The affect being most notable at the start of the pandemic and affecting the research activities of PhD students and junior staff, in particular. At the same time, they report



supporting measures taken to minimise the impact (including extension of contracts). After an initial period, staff regained access to key research facilities and were making good progress despite limitations of access to buildings and lack of normal departmental activity.

From the various conversations during the virtual ‘at-site visit’, it became apparent to the committee that all members feel ‘at home’ in the department. This is true for all levels of academic staff, including PhD students. The organized moments of interaction, such as the weekly chat by the head of the department, clearly help to achieve this. The management of the department is to be commended for achieving this open, constructive and welcoming atmosphere. The Department places particular emphasis on a healthy work-life balance and role models this from the top. Staff and PhD students all appreciated the attempts to balance out priorities, particularly during the Covid-19 pandemic period.

4.3 Research quality

DPG has a strong academic reputation both nationally and internationally and a high scientific output. What is very encouraging is that DPG staff regularly publishes in high impact journals such as Nature and PNAS. The number of peer reviewed papers has been stable over period 2014-2018 (~ 110 per year), peaking in 2019 (with 168). The peak may reflect the increase in academic staff over the last five years. The average number over the full reviewing period is ~14 papers per faculty (scientific staff) fte per year, respectively 2.7 per total research staff (fte) per year (Appendix B.2). The quality of the scientific research output is also high, showing a slight increase in the percentage of articles in the top 25% journals (from 66 to 74%), while the percentage in the top 10% is rather stable (~50%). Furthermore, a clear increase is seen across all impact factors. An average citation (CiteScore) of more than six per year is certainly a nice number.

The high quality of the research is demonstrated not only by the number and quality of publications, but also by the many international awards and prestigious grants received by the group. The recognition achieved by many of the young scientists is impressive and is promising for the future development and success of the group. Overall, it is remarkable to see the many excellent marks of recognitions received and learn about the many research highlights, which are truly highlights. The societal relevance of the research is high and the group is very active in various outreach activities.

DPG appears a successful and committed research group, able to respond to new research opportunities as they open. The rather flat organisational structure and the collective involvement of senior staff in management likely has benefitted the research activity as well as quality. This coupled with a healthy work-life balance at all levels in the organisation has contributed to a research environment where both staff and PhD students thrive. Researchers work collectively on topics and clearly value the collaboration and the increase in interdisciplinary research that has resulted. In this realm, the group addresses contemporary local and global challenges, which are interwoven with society, the socio-economic system, and land use change. DPG seeks to tackle these challenges through measuring and monitoring using, often newly developed, in situ or remote sensing techniques, and numerical or conceptual modelling across scales. Results and knowledge that support water managers in the Netherlands and worldwide.

4.4 Societal relevance

DPG has identified six impact themes and implemented a societal impact paragraph as an element of its long-term strategy. This is an important step towards integrating societal relevance in all activities at the department, creating what is referred to as an “impact culture”. Different stakeholder groups have been



identified and are specifically targeted, not only as part of a communication strategy, but also through direct involvement in (mission driven) research proposals. Thus, the interaction is seen as a two-way process, which is considered vital and further helps funding impact activities. A senior staff member is assigned ‘impact coordinator’, and impact is monitored through altmetric analysis. Societal impact is a new criterion in the yearly staff assessment and imbedded in the new merit promotion pilot at UU. Overall, the new merit system gives more flexibility in the hiring of staff.

The fact that the societal relevance and impact are thoroughly addressed, and that the department is proactive in terms of measures taken and involvement at all levels, reflects its sound standing in the organisation and should be commended. A series of narratives show that in terms of science communication and active involvement of stakeholders, it is hard to do better. One suggestion could be to focus on not only communicating science to potential users and the public, but also to think how one might contribute to the political debate on some of the more contentious issues. Overall, a very impressive strategy and high-level outreach activities undertaken by the staff addressing a wide range of stakeholders and target audience.

4.5 Viability

DPG is considered very viable; it is a high-quality research department working on issues that are of high relevance to society. The SWOT analysis raises some concerns that may influence the robustness and stability of the organisation, such as maintenance and support of research facilities (including data, software and models), restructuring of the NWO, a shift in funding away from science-driven research, rapid changes in research policy (university and government) and the Covid-19 pandemic (mobility and ability to perform field work). While DPG is right to point to the risks associated with the uncertain and shifting funding landscape, the committee trusts that the department – being a dynamic group with a proven record of attracting research funding – will meet the challenges and respond to opportunities ahead: after all, the department has maintained its funding base over the last five years. DPG’s strong national and international network and strategic partnership by endowed chairs and external associate professorships, further add to this. The department members are well aware of the fact that shifts in the funding base may affect the possibilities to carry out ‘blue sky’ research, but it is reassuring that they manage to integrate fundamental research in mission-based projects. The committee has some concern, however, that funding programmes should not become mission-driven only: fundamental research remains essential for a department such as DPG.

DPG has specifically used its financial reserves to hire talented early and mid-career scientists with a high potential to secure external funds through a flexible hiring strategy, whereby selection is based on the appreciation of talent rather than formal elements. This, along with the combination of detailed knowledge on Earth surface dynamics and expertise on a wide range of technologies used in Earth surface process studies, from lab experiments over field observations to modelling, suggests that the group is well placed to respond rather rapidly to new possibilities. With a recent focus on interdisciplinary research and wider collaboration within the Faculty, DPG see themselves well placed to address and response to societal challenges and sustainability in the future.

The SWOT reports maintenance and continuous support of physical research facilities, software, models and data as a threat. Currently such support depends partly on soft funding, whereas use of the equipment is still free for all. Budgeting the use of infrastructure is becoming more common, but could be further encouraged in future research applications. Important assets for the department are its central role in the maintenance of certain databases and the fact that software developed at the



department is widely used. Care should be taken to make sufficient investments to maintain such assets as they are of key importance to the international visibility of the department.

The option to differentiate the research/teaching balance, either temporarily (partial teaching relief to allow more time for activities such as proposal writing) or on a more permanent basis (reflecting diverse career paths), is important. At the same time, it is vital that each academic staff member does participate in the research and teaching efforts of the department. This ensures that all members remain fully engaged in the development of the department as a whole. Temporary staff expressed a need for more flexible contracts, for example, provisional part time positions.

The management team is well embedded in the organisation, reflecting a rather flat management structure. This facilitates a close interaction between senior and junior staff (as well as PhDs), across DPG chairs and research lines, ensures a stimulating and good working environment attracting talented staff. Still, junior staff mainly refer to their professors (chair groups) for information and informal discussions, and express a wish to meet more regularly across chair groups (and departments) - not only for management issues, but also for science discussions. On the whole, there are many opportunities of support for junior staff, including funding options, and they have reduced teaching load the first year to allow more time for grant applications. If not successful, some (limited) resources are available at the department level. Valuable remarks are made related to the DORA declaration challenging existing culture of 'quantity and metrics', as well as new funding opportunities.

There is a clear succession plan for the senior management with a new head taking over (after six years, two terms) next year and a new Director of Research taking over the year after. In an organisation with few conflicts, such as DPG, this seems to work well, and would normally ensure a smooth transition period. Nevertheless, the review panel encourages a critical reflection on potential weaknesses and risks identified during this transition to new leadership.

4.6 PhD programme

The programme appears to be in good shape, including the recruitment process, supervision, support and progress monitoring (regular assessments). The department has on average 2.8 PhD students per research faculty fte (Appendix B.2) and there are ~5 PhD completions per faculty research fte over the review period. DPG has established a protocol for supervision and teaching of its PhD candidates, which along with formalising of teaching duties for PhD students (~10%, corresponding to two courses per year) is well received by the PhD group. It is common to have at least two supervisors who meet regularly with their students (~ weekly) to provide guidance and support. The feedback from the PhD students is positive and they are happy with the supervision and support they get. There is a formal assessment at 6 and 9 months when a go/no go decision is made. At 2-years, a mid-term progress seminar is organised together with DES, providing valuable feedback to the students. However, less than 10% complete their PhD within four years and the success rates have been declining over the period, which is a concern albeit numbers are small. Of the 52 students starting during 2011-2015, 25% have not yet finished (~12% discontinued). Extension is not normally granted and it is common to start working part time while finishing the PhD, which partially accounts for the long completion times. The career trajectories of the candidates are sound: of the 44 PhD graduates over the period, about 70% remained in academia or got a position at a research institute.

Formal training includes a combination of selected courses (soft skills such as scientific writing, communication) and one compulsory course (Ethics and Integrity), constituting on average 10% of their time. In addition, informal training is offered (e.g. programming, design of research strategy) and self-training takes place among students. In general, the students report a positive atmosphere of helping



each other and knowledge sharing across the PhD group. Students report that project management is vital to learn at the start of your PhD (course is available). DPG should consider making some parts of the informal training more formal, notable courses in project management and specific techniques (e.g. programming or other scientific issues).

Discussion and information sharing also takes place at the Faculty level through the PhD council, where also management takes part (joint meetings). Guidance on career plans is provided by a career officer at the Faculty level.

4.7 Research integrity

The Code of Conduct for Scrupulous Academic Practise and Integrity is a sound document addressing key aspects of research integrity. It is important that the threshold for reporting misbehaviour is low and safe, and this seems well taken care of at the Utrecht University, which has established procedures for reporting issues. DPG has an open research culture, encouraging students and staff to share preliminary results at internal meetings. They also have an open science policy towards sharing software and data, with the FAIR principles as a goal. No research integrity issues were addressed by the department or identified during the interviews and DPG stands forward as a healthy working environment.

4.8 Diversity

DPG reports an improvement in international diversity; the current level of ~30% non-Dutch staff is considered a good balance (although no comment on the optimal fraction is provided). Further, DPG members work all around the world, and thus have the opportunity to make special efforts to involve local scientists in their 'remote' programmes.

In contrast, gender diversity has decreased (a reduction in female staff from 38% in 2014 to 26% in 2019), which is a concern. There are particularly few women among the tenured staff (two female professors in 2019) and there is limited turnover and few open positions in the near future. However, a positive achievement is the 35-40% gender balance in non-tenured positions. DPG demonstrates a clear commitment to provide equal opportunities as formulated in its strategy to improve gender and diversity balance, the 'DPG Diversity Action Plan (2019-2024)'. The assessment report along with the Diversity Action Plan addresses this challenge in a thorough way and provides many valuable reflections on how to improve the current situation. International research points to the need for the diversity challenge to be anchored at the leadership level, which seems to be the case for DPG and the Utrecht University. Furthermore, gender research within academia highlights the presence of role models as important in recruiting and keeping female staff.

Measures taken to improve diversity include advertisements that are more open and actively recruiting female researchers, which has resulted in some "small successes". Aspects to consider beyond those discussed in the self-assessment report include: (i) bias training for staff involved in decisions at all levels, (ii) active use of female adjunct positions (endowed chairs) as a way of increasing the number of female staff and thus role models, (iii) ensuring that there is not a loss of female talent moving from PhD/Postdoc level to non-tenured and tenured staff, and (iv) create network and professional support to assist the career planning of promising female candidates.



4.9 Recommendations

- Continue the strategy of maintaining the current staff numbers – achieved through the successful hiring of talented young and early-mid career scientists – as consolidation is now critical for long term financial viability;
- Work towards securing technical support and funding for maintenance of (the rather extensive) research facilities, including field and lab facilities as well model, software and data science infrastructure;
- Involve junior staff more in management and give them responsibility (e.g. as member on committees), which also helps building their CVs;
- Review the new merit promotion process, which adds outreach/valorisation activities as one of the criteria considered for evaluation, to gauge its success and adjust as appropriate;
- Work towards improving the completion rate of PhD students by investigating the main reason for the low completion rate within expected time and take appropriate measures;
- Build strategical international partnerships to increasing the success rate in EU programmes;
- Continue to work proactively towards reducing the gender imbalance at all levels in the organisation.



5. Department of Earth Sciences, VU University

5.1 Quantitative assessment

The committee assessed the quality, societal relevance and viability of the Department of Earth Sciences of VU University both quantitatively and qualitatively. Its PhD programme, research integrity and diversity are assessed qualitatively. For the quantitative assessment a four-point scale is used, according to the standard evaluation protocol 2015-2021. The explanation of the criteria underlying the scores can be found in appendix C. The qualitative assessment of the Institute can be found in the next sections.

Given the standards laid down in the SEP, the committee has awarded the following scores to the Department:

Research quality:	2
Relevance to society:	2
Viability:	2

5.2 Organisation, strategy and targets

The Department of Earth Sciences (VU-ES) aims to develop a research programme in Earth System science that is internationally recognised and fully integrated with education, with a mission to understand Earth as an integrated dynamic system and, through this, address the changing needs of society.

A reorganisation in 2014 required an immediate focus on providing a sustainable and stable work environment. The 2015 review was conducted shortly after this reorganisation, which included restructuring research groups into two clusters - Geology & Geochemistry and Earth & Climate – with each cluster comprising six Professor-led research groups. At the time of writing the 2020 self-assessment, the department had decided that the cluster approach was not entirely successful, in large part because the cluster structure did not promote sufficient interaction within the department. For this reason, VU-ES has decided to abandon the cluster approach, instead focusing on themes that will evolve with changes in staff, hoping that this structure also will stimulate interdisciplinary research between groups.

The overall department strategy has been developed with consideration of the VU vision of sustainability, entrepreneurship and diversity. The sustainability umbrella encompasses ES research in the areas of climate change, geohazards, natural resources and energy transition; all have direct societal relevance in addition to presenting fundamental research challenges, and therefore naturally contribute to both the quality and societal relevance of the research. In that regard, 15 new staff members have been hired to support teaching and strengthen research. The prospect of future hires will allow VU-ES to continue along this path. At the same time, a planned move to a new building in 2023 should offer new opportunities for interaction and collaboration within the department as well as beyond. Originally co-location was sought for with the department of Ecological Sciences and Institute for Environmental Sciences (the three EEs), but this did not prove possible (will be located in three different buildings). Still, improved collaboration is foreseen within teaching as well as research and marketing, supporting a better integration of sustainability across all activities.



During the review period, VU-ES also became the first department in the Faculty to introduce tenure tracks. The early year groups in this programme had a difficult time, but management has now developed a consistent and transparent system that should serve them well in the future.

The laboratory facilities within VU-ES are excellent, but are described as working at maximum capacity. There has also been a pronounced loss of technician support over the last five years because of a decrease in funding at the Faculty level, although some external projects budget for technical support. This presents a challenge as many labs are now run by individual groups, often with reliance on postdocs and students. The move to a new building in 2023 will substantially improve the quality of the laboratory space, although some heavy equipment will be housed in a different building.

The impact of Covid-19 was primarily to exacerbate an already precarious balance between teaching and research. All staff agreed that the change to on-line teaching required a huge effort this year, but anticipate that the experience with on-line teaching will help to make teaching more efficient in the future. The senior staff, in particular, feel overloaded with teaching but are also committed to maintaining a very broad earth science department and teaching commensurate with that breadth.

Taken together, it appears that VU-ES has developed a strategy that is working to produce high quality research with societal impact. This includes success in hiring, in funding and in collaborative work both within and outside of the Netherlands. The past six years has also seen a small net increase in staff and steady increase in PhD students, but a substantial decrease in technical staff. The funding numbers fluctuate (as is common), but are generally holding steady, as are both the number and quality of publications.

5.3 Research quality

Research at VU-ES includes a broad range of scientifically and societally relevant research topics – including climate, geohazards, petrology, tectonics and planetary science – as well as innovation in techniques, experiments, climate simulations and applications of remote sensing. The research approaches also suggest a good balance between modelling, remote sensing and data collection and analysis.

The output indicators provided to the review committee are strong and include a consistent level of annual awards, invitations for keynote lectures, contributions to editorial boards and a healthy level of research funding, including from NWO (Vici and Vidi), ERC (starting grants) and an IUGS Early Career award. The self-assessment also documents several early career and presentation awards to PhD students and postdocs. The number of the early career faculty who have received awards, in particular, speaks to the quality of the recent hiring practices and support for early career research.

The research output rate is impressive; with ~19 peer reviewed publications per research faculty (scientific staff) fte per year, respectively 4.1 per total research staff fte/year (Appendix B.3). There has been a slight decline in both the number of publications and in the fraction of papers in the top 25% and 10% research journals over the review period, which is likely a consequence of personnel changes, with a large number of recent hires. The highest level of citations is for researchers in the fields of isotope geochemistry and climate-related studies. The department has ranked consistently in the top 51-100 Earth Science departments in global QS rankings, consistent with the strong, but not outstanding, citation record. External funding is healthy, especially for early career researchers, who have been awarded 2 ERC starting grants and an IUGS early career award. Faculty have also been successful in obtaining NWO Vidi (1) and Vici (3) awards. The number of PhD students has increased steadily during the review period (from 22.24 to 33.54 fte; Appendix B.3, Table 1); the number of postdocs dropped from 2015 (13.95 fte) to 2016 (7.83 fte), but has slowly increased since then (to 11.97 fte in 2019).



The laboratory facilities are impressive and often innovative; they have clearly contributed to the general success in attracting EU funding as well as to many of the high-profile publications.

The self-assessment suggests some aspects of research and research organisation that could be improved. These include addressing some staff imbalances in research engagement and achievement, and improving collaboration among research groups, potentially fostering more interdisciplinary research. VU-ES is starting to address these problems by restructuring (abandoning the cluster structure) and with new staff hiring.

5.4 Societal relevance

The relevance of VU-ES research is high, with many research topics closely related to the VU 'sustainability' theme; examples include climate change and its causes and impacts, depletion of natural resources, geohazards, and energy transition. More specifically, the department boasts fundamental knowledge on subjects that include greenhouse gas dynamics in forests and peatlands, underground CO₂ storage, geohazards (including studies of the Dutch coastal dune system in addition to volcanoes, earthquakes and landslides), and atmospheric and ocean dynamics. This breadth of research relevance is demonstrated by both the key papers provided and the staff and PhD student publications more broadly. Another measure of impact is the extensive contract research done by the sediment, stable isotope and geochronology laboratories.

Broader impacts related to VU-ES research are enhanced by the engagement of VU staff with SRON and GCOS (Earth observation), NESSC (Earth Systems Science) and ICOS (carbon) in addition to international collaborations. The staff also regularly engage in direct public outreach via the media and papers targeted at a general audience. Media outreach is supported by a faculty member who is part-time journalist, which helps maintain relations with the press. The applied contribution of the research lies primarily in the extensive contract work provided by in-house laboratories (see above) in addition to bespoke equipment related to laboratory analyses.

As a department, VU-ES has made the decision to raise the visibility of sustainability in the bachelor and master programmes. This decision is timely and should continue to improve research relevance and student recruitment. Importantly, integration of research themes and educational goals help to underpin VU's *Science for Sustainability* theme.

As for other Earth Science departments, however, VU-ES faces challenges in shifting emphasis from fundamental to societally relevant research, as well as in developing ways to translate scientific research into measurable impact. The stated vision is to develop societally relevant research programmes from the perspectives of both applied and fundamental research. The committee's view is that the structural changes outlined in the self-assessment, including both abandoning the clusters and adding transparency to decision-making, will help VU-ES as a whole to navigate the balance between these two approaches and invites the department to formulate a clearly spelled out vision on how to further develop societal relevance and impact

Overall, the committee found VU-ES to be very engaged with both research and teaching relevant to broad themes of sustainability and Earth environment. Developing a clear and coherent plan for moving forward in these directions would help to place the department in a strong position for obtaining new funding and maintaining a strong student population in a rapidly changing funding and teaching environment.



5.5 Viability

Viability is addressed in the self-assessment via the SWOT plan, which is thoughtful and honest. The department presents a sense of optimism and enthusiasm that arises from the large number of new hires and the potential for new research directions, as well as recognition of success in obtaining research funding. There is also cautious optimism about the move to the new building, particularly the promise of an improved work environment, while at the same time there is apprehension about separation of research and teaching into two buildings, as well as a shortage of lab space.

The shift in department emphasis toward sustainability is important strategically and will help long-term viability. There is a clear interest in cross- and trans-disciplinary research and teaching shows a broad support for this approach; one concern, however, is how to move toward a sustainability focus while at the same time maintaining breadth in all of Earth Sciences. An additional challenge relates to developing ways to promote and facilitate cross-disciplinary research.

The move to a new building will improve the work environment overall, but could present a challenge to interdisciplinary studies, particularly as Earth Sciences will not be in close physical proximity with natural collaborators in the broad area of sustainability.

There is a critical need for more support for laboratory infrastructure, which provides an important focus for collaborative research. Challenges to laboratory work that were mentioned by the researchers include both a shortage of space in the new building and declining technical support from VU. As already mentioned, with the upcoming move to the new building the number of square meters of lab space will indeed be reduced, but quality of the lab space will be significantly improved. There will be no shortage of laboratory space for current infrastructure, although some parts (heavy, vibrating equipment) will be located in a different building. It might be a challenge to accommodate growth of lab infrastructure in 5 to 10 years from now, if all current lab infrastructure will remain. The committee recommends that information about the facilities that will be available in the new building is communicated to the staff as soon as it is available because this will help to reduce uncertainty and will allow researchers to develop.

The current management structure is based around existing research clusters. One challenge for the coming year is to re-think this structure in light of eliminating the two clusters in favour of a more flexible organisation of research themes. If managed well, this restructuring should allow VU-ES to respond rapidly to changing research and funding opportunities. Also useful would be a clear articulation of the succession plan for senior management, particularly with regard to improving diversity as more women are promoted to senior staff. In part this is being addressed in conjunction with the introduction of a tenure track, which is the first in the Faculty and therefore has required some adjustments through time. The committee's interviews indicate that now junior faculty have a clear understanding of the process and expectations. At the same time a 'career track' has been introduced for female faculty, with the goal of fast-tracking advancement of talented female researchers to increase gender equity at higher academic levels.

More general concerns about viability are common to Earth Science programmes in many places, including ongoing challenges related to attracting students and large uncertainties about funding in the short term because of the pandemic. Active recruitment of talented young faculty members, as highlighted in the future strategy planning, is clearly a good way to address both problems.

The work-life balance in the department appears sustainable for most of the group, although it remains a challenge for some and should be carefully monitored.



5.6 PhD programme

The PhD programme has been run within the VU Graduate School for Earth, Environment and Ecology. Starting this year (2020), VU-ES has joined a national research school (SENSE), which provides a broader peer group for training and research as well as adding relevance in terms of sustainability and interdisciplinary research. The department has on average 2.5 PhD students per research faculty fte (Appendix B.3, Table 1) and there are ~6 PhD completions per faculty research fte over the review period. PhD theses cover a wide range of topics and comprise chapters that are, or will become, published research papers.

The supervisory structure for PhD students seems reasonable and the training effective, as evidenced by the number of PhD theses completed (62 in the evaluation period) and the breadth of research topics. Our discussions showed that the PhD students feel well supported by their supervisors. One concern, however, is that this supervision is within research groups and therefore suffers from a lack of consistency across the department. A new addition is a PhD coordinator, who has clearly improved the PhD experience and should help to insure a more consistent PhD experience.

The new SENSE structure is received with general enthusiasm by the students; they also appreciate the 30 EC of training, including the required courses related to project management and impact, as well as for optional courses, such as scientific writing and proposal writing.

The self-evaluation document provides data on PhD completion (Appendix B.3, Table 4) starting with 2014 and therefore includes a large number of students who are still in the programme. This overall assessment states that about 50% of PhD students require five years or less to finish, which is a year longer than the length of appointment. One reason given for the time to completion is lab access, although the students that the committee interviewed found the facilities to be well-organised and easily accessible (even during the pandemic, after the initial lockdown). Other factors mentioned are the number of publications required, although this number seems standard for other institutions, and the tendency of PhD students to start employment if not finished within the contract period (i.e. working part time on their PhD completion).

Student work-life balance appears sustainable and there is good integration of Dutch and non-Dutch students. That said, some PhD students found the combined requirements of teaching and coursework to be demanding. The students also felt well supported this (Covid-19) year. The primary impact of Covid-19 was on field-based research projects, which can hopefully move forward in 2021.

Student placement in jobs seems excellent, with most employed in industry or governmental agencies.

5.7 Research integrity

VU requires students to take a class on scientific integrity and to become familiar with the VSNU code of conduct. The FAIR principles have also been adopted. Conflicts between PhD student and supervisor are handled by either the PhD coordinator or a faculty scientific integrity counsellor. This appears consistent with standard practice elsewhere.

Data management is a work in progress at VU, as is true elsewhere. The primary challenges are the ever-increasing amount of data collected and pressure for open access. VU-ES has three pilot projects to facilitate automated processing and storage of field and laboratory measurements and publication of existing data sets, all of which seem important for future data handling.



5.8 Diversity

The post-doc and PhD population is largely non-Dutch, which speaks to the outside perception of educational quality. Students and staff also see no separation between Dutch and non-Dutch members of the department, showing that it is well-integrated.

The total research staff shows reasonable gender diversity, with approximately 1/3 female. Within the total research staff, PhD students and postdocs approach the equal balance between male and female that characterises the undergraduate population. The Faculty is less diverse, however, and most of the diversity lies in the more junior staff members, of whom 36% are female. To maintain this diversity will require (1) that the assistant professors are promoted and (2) that recruitment continues to be diverse at the junior level. Toward this end, a new 'career' track has been added to assist talented young scientists in the promotion process. The committee found in their interviews, however, that this track was not as well understood by some department members as it is to management.

More broadly, there remains a difference in the percentage of women at the PhD/postdoc level relative to the percentage of female assistant professors. The management team is aware of this discrepancy and is looking carefully at recruitment efforts, including how job ads are written. In part this reflects a more general loss of female talent in Earth Sciences when moving from the PhD/Postdoc level to that of non-tenured and tenured staff. From a management perspective, it is important to provide early career women with opportunities to build their CV (e.g., by invitations to join projects, be co-authors, take on research responsibilities). International research also points to the need for the diversity challenge to be anchored at the leadership level. For example, it would help to have formal training for everyone on unconscious bias and to consider hiring more senior women as role models, e.g. in adjunct positions.

5.9 Recommendations

- There is a critical need for University support for laboratory facilities (including both space and technical support);
- Management needs to re-think department structure now that the cluster concept is being abandoned. This is particularly important as, in many ways, the department has not fully recovered from the 2014 re-structuring. Points to consider include: (1) increasing participation in department-level discussions, particularly the junior staff; (2) developing a mechanism to form and disband research interest groups; (3) stimulating interactions both laterally and vertically within the department; (4) creating a structure for developing big picture questions that could foster collaborative research, particularly on topics of societal relevance; and (5) developing a clear succession plan that will improve diversity in conjunction with changing diversity of senior staff.
- The high teaching load, and the stress that it appears to be causing, suggest that VU should carefully evaluate the teaching portfolio, particularly with respect to identifying overlaps with EEE.
- If collaborative work is deemed important, collaboration could be included as one metric for promotion;
- There is a need for transparency how teaching loads are assigned, particularly for junior staff and PhD students;
- The increasing emphasis on sustainability is good for the department's continued relevance and visibility, but poses a challenge to maintaining broad strengths in all Earth Science disciplines. Key is the need to present a coherent vision that connects VU-ES teaching and



research to national needs/strategies and highlights the unique contributions of VU-ES within this structure.



Appendix A - Programme of the site visit

Wednesday November 11

Time	Part
15.00 - 15.30	Introduction
15.30 - 16.00	Welcome by Deans of UU and VU
16.00 – 19.00	Preparation meeting

Thursday November 12

Time	Part
UTRECHT UNIVERSITY – EARTH SCIENCES	
08.30 - 09.10	management
09.10 - 09.20	break
09.20 - 09.45	phd
09.45 - 10.00	break
10.00 - 10.35	senior staff
10.35 - 10.45	break
10.45 - 11.20	junior staff
11.20 - 11.40	break and preparing questions for 2nd meeting management
11.40 - 12.00	2nd meeting management (additional questions)
12.00 - 13.00	lunch
13.00 - 13.30	reflecting UU-ES
UTRECHT UNIVERSITY – PHYSICAL GEOGRAPHY	
13.30 - 14.10	management
14.10 - 14.20	break
14.20 - 14.45	phd
14.45 - 15.00	break
15.00 - 15.35	senior staff
15.35 - 15.45	break and meeting committee
15.45 - 16.20	junior staff
16.20 - 16.40	break and preparing questions for 2nd meeting management
16.40 - 17.00	2nd meeting management (additional questions)
17.00 - 17.30	reflecting UU-PG
17.30 - 18.00	overall reflection first day



Friday November 13

Time	Part
VU UNIVERSITY – EARTH SCIENCES	
08.30 - 09.10	management
09.10 - 09.20	break
09.20 - 09.45	phd
09.45 - 10.00	break
10.00 - 10.35	senior staff
10.35 - 10.45	break
10.45 - 11.20	junior staff
11.20 - 11.40	break and preparing questions for 2nd meeting management
11.40 - 12.00	2nd meeting management (additional questions)
12.00 - 13.00	lunch
13.00 - 13.30	reflecting VU-ES
13.30 - 16.00	committee meeting, drawing first conclusions
16.00 - 16.30	Overall presentation



Appendix B.1 - Quantitative data Earth sciences UU

Table 1 Research staff in fte ES-UU

	2014	2015	2016	2017	2018	2019
Scientific staff	18.5	20.2	20.7	20.5	19.5	19.5
Post-docs	35.1	40.0	43.5	32.1	33.1	36.7
PhD students	55.5	56.7	56.8	54.9	48.0	50.6
Total research staff	109.1	116.9	121.0	107.5	100.6	106.8

Table 2 Funding – ES-UU

	2014	2015	2016	2017	2018	2019
<i>Funding in fte</i>						
Direct funding general	12.2	13.8	13.9	17.2	17.3	18.6
Direct funding competitive	5.8	6.8	6.0	0.6	0.5	1.1
Research grants	50.0	51.0	51.5	49.1	41.8	41.1
Contract research	41.2	45.3	49.6	40.6	41.0	46.0
Total funding	109.1	116.9	121.0	107.5	100.6	106.8
<i>Expenditure in k€</i>						
Personnel costs	8,916	9,542	9,972	9,437	9,420	9,673
Other costs	2,030	3,546	3,222	2,542	3,497	5,682
Total expenditure	10,946	13,088	13,194	11,979	12,916	15,355

Table 3 Research output – ES-UU

	2014	2015	2016	2017	2018	2019
Refereed articles	267	270	281	267	304	264
Non-refereed articles	-	3	2	-	2	2
Books	-	-	2	2	3	3
Book chapters	6	22	8	7	7	8
PhD theses	20	27	16	25	14	31
Conference papers	8	13	13	9	6	6
Professional publications	26	15	12	8	11	4
Other research output	186	181	197	86	85	70
Total	513	531	531	404	432	388



Table 4 PhD completion – ES-UU

Enrollment				Success rates											
Starting year				≤ 4 yr		≤ 5 yr		≤ 6 yr		≤ 7 yr		Not yet finished		Discontinued	
	F	M	F+M	#	%	#	%	#	%	#	%	#	%	#	%
2011	10	6	16	1	6	10	63	13	81	14	88	1	6	1	6
2012	11	6	17	1	6	10	59	11	65	14	82	2	12	1	6
2013	6	6	12	0	0	8	67	8	67	8	67	3	25	1	8
2014	12	14	26	1	4	14	54	20	77	20	77	4	15	2	8
2015	6	10	16	0	0	10	63	10	63	10	63	3	19	3	19
total	45	42	87	3	3	52	62	66	66	13	15	8	9	8	9



Appendix B.2 - Quantitative data Physical Geography UU

Table 1 Research staff in fte – PG-UU

	2014	2015	2016	2017	2018	2019
Scientific staff	7.2	6.9	8,2	8.8	9.6	11.0
Post-docs	6.1	10.8	13,6	17.0	11.2	11.5
PhD students	21.1	24.8	26.1	27.4	27.7	18.4
Total research staff	34.4	42.5	47.9	53.2	48.5	40.9

Table 2 Funding – PG-UU

	2014	2015	2016	2017	2018	2019
<i>Funding in fte</i>						
Direct funding	14.2	15.6	18.5	20.1	17.6	18.5
Research grants	15.8	22.5	22.8	23.4	24.2	17.7
Contract research	9.1	9.4	12.0	15.1	12.9	10.9
Total funding	39.1	47.5	53.3	58.6	54.7	47.1
<i>Expenditure in k€</i>						
Personnel costs	3171	3640	4116	4841	4949	4677
Other costs	749	1174	1057	914	800	832
Total expenditure	3920	4814	5173	5755	5750	5509

Table 3 Research output – PG-UU

	2014	2015	2016	2017	2018	2019
Refereed articles	117	121	107	79	121	168
Non-refereed articles	3	0	0	0	0	0
Books	1	1	0	0	0	0
Book chapters	6	6	2	3	2	2
PhD theses	6	6	7	7	8	10
Conference papers	6	9	6	12	3	5
Professional publications	8	11	7	6	4	6
Other research output	4	4	4	1	0	1
Total	151	158	133	108	138	192



Table 4 PhD completion – PG-UU

Enrollment				Success rates											
Starting year				≤ 4 yr		≤ 5 yr		≤ 6 yr		≤ 7 yr		Not yet finished		Discontinued	
	F	M	F+M	#	%	#	%	#	%	#	%	#	%	#	%
2011	4	6	10	2	20	7	70	7	70	8	80	1	10	1	10
2012	5	3	8	1	13	6	75	7	88	7	88	0	0	1	13
2013	3	7	10	0	0	3	30	7	70	7	70	1	10	2	20
2014	9	4	13	1	8	6	46	8	62	8	62	4	31	1	8
2015	3	8	11	0	0	3	27	3	27	3	27	7	64	1	9
total	24	28	52	4	8	25	32	33	33	13	25	6	12	6	12



Appendix B.3 - Quantitative data Earth Sciences VU

Table 1 Research staff in fte – ES-VU

	2014	2015	2016	2017	2018	2019
Scientific staff	10.50	10.26	9.90	9.70	10.90	11.26
Post-docs	13.95	13.95	7.83	8.33	10.94	11.97
PhD students	22.24	20.72	23.76	27.92	28.40	33.54
Total research staff	46.69	44.93	41.49	45.95	50.24	56.77

Table 2 Funding (not solely research) – ES-VU

	2014	2015	2016	2017	2018	2019
<i>Funding in fte</i>						
Direct funding	48.1	32.6	41.6	49.2	34.5	50.3
Research grants	13.9	23.4	20.0	30.4	32.7	21.4
Contract research	18.8	8.3	28.9	19.7	18.5	14.1
Total funding	80.8	64.3	90.5	99.3	85.7	86.1
<i>Expenditure in k€</i>						
Personnel costs	7.266	6.556	6.504	6.742	5.810	6.298
Other costs	2.174	2.112	2.070	1.915	2.400	1.955
Total expenditure	9.440	8.668	8.573	8.658	8.210	8.252

Table 3 Research output – ES-VU

	2014	2015	2016	2017	2018	2019
Refereed articles	220	195	192	190	195	186
Non-refereed articles ¹	27	6	7	4	5	2
Books		1	1	1		1
Book chapters	10	11	15	10	3	6
PhD theses	14	9	5	9	14	6
Conference papers	4	2	10	11	2	5
Professional publications ²	11	10	2	3	6	1
Publications aimed at the general public	2	6	10	6	3	
Other research output ³	1	9	3	6	12	13
Total	289	249	245	230	240	220

1. Articles in journals that are non-refereed, yet deemed important for the field
2. Publications aimed at professionals in the public and private sector (professionele publicaties), including patents and annotations (e.g. law)
3. Other types of research output (if applicable), such as abstracts, patents, editorships, inaugural lectures, designs and prototypes (e.g. engineering)



Table 4 PhD completion – ES-VU

Enrollment				Success rates									
Starting year	F	M	F+M	≤ 4 yr		≤ 5 yr		≤ 6 yr		Discontinued		Not yet finished	
				#	%	#	%	#	%	#	%	#	%
2014	6	12	18	10	56	12	67	13	72	2	11	3	17
2015	8	4	12	4	33	4	33	-	-	0	0	8	67
2016	2	12	14	3	21	4	28	-	-	0	0	10	72
2017	6	2	8	-	-	-	-	-	-	-	-	8	100
2018	3	8	11	-	-	-	-	-	-	-	-	11	100
2019	3	7	10	-	-	-	-	-	-	-	-	10	100
Total	28	45	73	17	23	3	4	1	2	-	-	50	68



Appendix C – Meaning of the scores

Category	Meaning	Research quality	Relevance to society	Viability
1	World leading/ excellent	The research unit has been shown to be one of the few most influential research groups in the world in its particular field	The research unit makes an outstanding contribution to society	The research unit is excellently equipped for the future
2	Very good	The research unit conducts very good. internationally recognised research	The research unit makes a very good contribution to society	The research unit is very well equipped for the future
3	Good	The research unit conducts good research	The research unit makes a good contribution to society	The research unit makes responsible strategic decisions and is therefore well equipped for the future
4	Unsatisfactory	The research unit does not achieve satisfactory results in its field	The research unit does not make a satisfactory contribution to society	The research unit is not adequately equipped for the future

