Assessment Committee Report on Research in Geosciences 2015-2020 Delft University of Technology

June, 2022

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"Cherish, involve and train your talents"

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Title:
Assessment Committee Report on Research in Geosciences, 2015-2020 at the Delft University of Technology

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SUMMARY

The Assessment Committee assessed the research of the Department of Geoscience and Engineering (GSE) and the Department of Geoscience and Remote Sensing (GRS) of the Faculty of Civil Engineering and Geosciences (CEG). This assessment covers research in the period 2015-2020. The Assessment Committee Report is approved by all Committee members.

Overall Conclusion

Geosciences at TU Delft is at the forefront of scientific research. The Departments have been able to change direction towards highly societally relevant research topics of climate change and the energy transition. The Departments have a very well-equipped infrastructure and facilities, a healthy financial situation and outstanding young as well as senior research staff. Also, it has been able to recruit excellent new staff. These staff – especially the young generation – could be even more cherished, involved in management and trained to make them flourish and happy.

'Hardware' like the organisational (matrix) structure, the themes, HR policies, strategies on outreach, monitoring educational load etc. etc. could all be fine-tuned, but the Committee would like to stress that it is the 'software', the people that make the difference – bottom-line: the organisation is only a vehicle to have people collaborate and interact with each other and make them flourish.

GSE

The research production of the GSE Department is of excellent quality, and it is expected to generate even more transfer of knowledge to society in the future. The GSE research objectives are of very high societal relevance since, in general terms, they concern the responsible use and exploitation of natural resources and underground space, and the mitigation of natural and human-induced geo-hazards. Also, the societal relevance of the GSE research is confirmed by the size of the funding acquired through research contracts which, excluding EU funding, reaching about 21M€ in the 6 year period. GSE researchers have acquired

prestigious grants (including an ERC advanced grant) and they participate in, or lead, large research projects.

The Committee was impressed by the outstanding experimental facilities, with many unique aspects, and a world-leading, excellent example in geothermal research well. They were pleased by the commitment to open sharing of experimental data and access to the facilities for researchers beyond TU Delft.

GSE feels like a dynamic Department – with a strong vision in where they want to go – and moving in the right direction. The Department is historically strong in fossil fuel research but has not only recognised the risk to viability but also taken action and developed a transition strategy: no new 'fossil research' and research funded by the fossil fuel industry should contribute and be useful for the energy transition.

An increase in open access publications has been recorded in the six years: open access journal papers increased from 49% to 77%. The general attitude to open transfer of the research data to scientists and society appears to have been strengthened.

The efforts on trying to accommodate everyone and to integrate staff in the Department are very convincing. Many initiatives have been started to improve the academic culture (including openness, safety, inclusiveness and diversity): an Academic Culture Committee (ACC) set up on faculty level, the hiring of a new faculty diversity officer, recruitment for faculty diversity and inclusion team started, *non-violent communication, implicit bias, and active bystander* training, and regulations for complaints at university level.

The Committee recommends GSE to:

[1] Continue making evident the impact of the whole GSE experience, e.g. by collaborating on Faculty-wide challenges of different hazard investigations and within the field of civil engineering;
[2] Put more effort in formal communication in advance of changes, initiatives, strategies, to mitigate misunderstandings and eventual unhappiness among younger staff;

[3] Rethink the themes, i.e. think about keeping one Theme ("Energy Transition") and define several sub-Themes under this umbrella.

GRS

The Committee observed excellent work in most of the research areas, and sometimes even outstanding quality at the GRS Department. A high number of peer-reviewed publications with significant international visibility was reported. The impressive number of third-party funded projects (national and international) shows the high quality and competitiveness of the research. The research areas and objectives are overall clear and well-defined. There could be a stronger internal interaction, for instance between the Geodesy and the Atmosphere themes. The merit of the research products is very well presented. GRS researchers have acquired prestigious grants (also ERC for either starters or consolidators) and they participate in, or lead, large research projects.

There is a clear relevance to society on the topics listed. Societal relevance and collaborative projects with societal institutions have been greatly improved compared to the previous assessment.

The matrix-system with section and themes system are not yet convincing to the Committee. The organic way of organising seems to work well.
The Committee formed the impression that (younger) staff were not always engaged in decision making.
GRS has been successful in attracting excellent talents. The MIT-hiring strategy "quality over niche" with broad job descriptions seems to have worked well.
The Committee noticed a strong demonstrated commitment to open sharing of datasets. The formulated themes on Geodesy, Earth System Science, Remote Sensing and Atmospheric Science sound overall more appealing than the more traditional names of the sections.

Overall the Committee noted an open and friendly attitude among staff members and leadership, and the Committee noted that critical comments are discussed with an open attitude.

The Committee recommends GRS to:

[4] Investigate the possibility of building stronger internal interactions, for instance between the Geodesy and the Atmosphere themes;
[5] Improve the contribution to more operational products that serve the scientific community and also have societal relevance;
[6] Keep investing in strategic collaborations with stakeholders to line up long-term activities;
[7] Rethink the section and theme names, as one common theme might even improve the collaboration;
[8] Provide more emphasis on operational products to the science community rather than focussing on basic research;
[9] Get a stronger focus on monitoring and predicting risks and natural hazards.

GSE and GRS

The Committee noticed that the PhD-candidates seem generally very happy. They report an overall positive onboarding and mentoring experience and the best practices formulated both for PhD students and guiding staff members is impressive. There has been a substantial improvement in the finishing times of PhD theses, with most theses recently finishing within 5 years. The Graduate School-system is generally working well and PhD candidates confirm that good practices generally seems to be followed.
Outreach is organised at University-level around some themes. This seems sensible. Training on the job for (classical) media is needed and, especially for the younger staff, training in outreach may be needed. The supporting communication department looks very professional and is highly relevant given the very high public interest. A lot of collaboration is taking places with industrial and (non-)governmental bodies.

Time spent on teaching differs greatly between staff members, from not involved in education (mostly part-time full professors) up to 60%. Teaching is seen an important aspect of relevance to society. Regarding the teaching-research nexus: lecturers have their own responsibility to bring in their research into teaching. This is often done as an assignment.

Postdocs appear poorly integrated into the Departments; they are not involved in decision making processes and not much is organised to support this group. The Departments are aware of postdocs as a 'lost group' and the Committee appreciates the ongoing discussion of this issue.

Tenure trackers seem overall quite happy. Some remarks for improvement are: the Committee noticed a weak process of onboarding: "everything has to be done at once" without prior experience or having received training. The Committee notices that tenure trackers frequently receive last-minute tasks, causing unnecessary stress.
In the longer term the system of getting early tenured could lead to a lowered quality of staff, since people are tenured that would otherwise have left. It is worth emphasising that this is a TU Delft HR policy and not a Department one. The Department will need to devise a HR strategy to avoid a situation where the procedure of awarding early tenure could lead to a lowered quality of staff, e.g. a more selective recruitment process.

Diversity has little improved in recent years. There are no systematic efforts to address this and the results are staying behind. Regarding diversity with respect to ethnicity and minority groups, the Committee notices awareness for these groups at the Departments – especially the implicit bias staff could have regarding diversity – but recognises little concrete action (yet).

The Committee received no convincing answer as to why the strengthening between GSE and GRS was a key objective for any community interviewed. The Committee therefore recommends to discuss the higher goal of cooperation. The identification of new common research themes, or of links within existing themes, could facilitate new connections.

Overall, the efforts on trying to accommodate everyone and to integrate staff in the Department are very convincing.

The Committee recommends GSE and GRS to:

[10] Organise PhD gatherings centrally and on a regular basis;
[11] Better promote courses to PhD-candidates;
[12] Make existing guidelines regarding the involvement of PhD students in teaching activities, in line with a general assessment of teaching responsibilities and clearly stated in the PhD policy known to the staff and act upon it;
[13] Prepare a strategy/ plan at the Faculty on how and when to step in the public debate.
[14] Further extend collaborations with industrial and (non-)governmental bodies as well as the Faculty CEG;
[15] Pay attention to the risks of scientific cooperation other countries regarding the protection of Intellectual Property;
[16] Investigate who decides who teaches which course and create a transparent policy;
[17] Present a more systematic and homogenised distribution of education;
[18] Revise the tenure track documents, either by looking for a better document in other departments, or by better tailoring the current document to the GRS and GSE situation.
[19] Look into ways of reducing the avoidable stress for tenure trackers caused by, e.g. last-minute tasks and the acquiring of funding;
[20] Install a Young MT at GRS to improve involvement of young staff;
[21] Consider this issue of early-tenure and define an 'escape' policy for less qualified staff members to other positions within TUD;
[22] Support women already in the department to be a role model for future female scientists (PhD-candidates, students, school pupils);
[23] Give diversity permanent and structural attention;
[24] Make courses on implicit bias and non-violent communication compulsory and repeated regularly;
[25] Work on an active outreach strategy that could capitalise better on sharing societally relevant science, especially by younger (PhD & Postdoc) staff.

Contents

PREFACE

Performing the research assessment 2015-2020 of Geosciences at TU Delft was quite an intensive experience for both the assessment Committee and the two departments, Geoscience & Engineering and Geoscience & Remote Sensing. Our journey as assessment Committee started mid-February, when we received the impressive self-assessment. It was clear immediately that a lot of effort was put in the self-assessment. During our site visit in March 2022, we learned that the making of the self-assessment itself produced many useful insights; not only ideas for improvements, but also the realisation of all the successes achieved over the past six years. Especially, the latter is important for self-critical organisations like Geosciences who are always looking to improve. It is important to regularly celebrate your many successes.

We are thankful for your openness in our discussions. This was key for us to make a good assessment and for us to make our recommendations. One of the questions we asked was 'the happy-question': 'are you happy and what makes you happy.' At first glance, perhaps a strange question for 'techies': what is the relevance of happiness when it comes to research quality, social relevance and viability? It turned out to be a question that unleashed a lot of discussion and passion. It shows that it is easier to create success when you are happy, and vice versa. We are convinced that it is good to keep asking this question. You will be surprised by the inspiration it creates.

Dr. Lely – one of the first students of TUD in the mid-19th century – dedicated his 'engineering craft' to improvement of society; Of course, most notably his 'Zuiderzeewerken'. At the time, the Zuiderzeewerken were enormous and revolutionary. The shoreline was shortened by building a 32km dike, creating a large, freshwater body (IJsselmeer), and huge polders were built. The ingenious combined solution provided safety from the dangers of the sea and a perfect environment for expansion of agriculture and housing. It is great to see that today's scientists and engineers continue to work in the same spirit to improve society; while Dr. Lely worked to improve society's living conditions, we now

work toward a sustainable planet for future generations. Science dedicated to a sustainable and healthy society.

Thank you for letting us be a part of your journey. We very much enjoyed it. For us the journey stops here. Of course, it doesn't stop here for Geosciences. We hope that our findings will be helpful in a successful and enjoyable continuation of your journey.

Bon voyage!

Hetty Klavers
Committee Chair

1. Assessment Committee and Assessment Procedures

1.1 Assessment Scope

The Assessment Committee was asked to assess the research of the Department of Geoscience and Engineering (GSE) and the Department of Geoscience and Remote Sensing (GRS), together referred to as Geosciences, of the Faculty of Civil Engineering and Geosciences (CEG). This assessment covers research in the period 2015-2020. In accordance with the Strategy Evaluation Protocol 2021-2027 for Research Assessments in the Netherlands (SEP), the Committee's tasks were to assess the quality, relevance to society, and viability of the research programmes on the basis of the information provided by the Faculty and interviews with Faculty management and research Departments. In its evaluation of these three criteria, the Committee took care to include the following specific aspects, as described in the SEP protocol: Open Science, PhD Policy and Training, Academic Culture and Human Resources Policy.

Following this, the Committee was to make recommendations for the future.

1.2 Committee Composition

The members of the Committee were:

Ir. H.C. (Hetty) Klavers, Committee Chair, Dijkgraaf (Chair), Waterschap Zuiderzeeland, The Netherlands.
Prof. dr F. (Federica) Cotecchia, Professor of Geotechnical Engineering, Politecnico di Bari, Italy.
Dr A.M. (Arjan) Droste, Scientist Emissions, Climate, Air & Sustainability group, The Netherlands Organisation for Applied Scientific Research (TNO), The

Netherlands.
Prof. dr A.A.M. (Bert) Holtslag, Emeritus Professor of Meteorology, Wageningen University and Research, The Netherlands**.**
Prof. dr M.D. (Matt) Jackson, Professor of in Geological Fluid Mechanics and Director of Research, Department of Earth Science and Engineering, Imperial College London, United Kingdom.
Dr K. (Katrin) Löer, Lecturer in Environmental Seismology, Department of Geology and Geophysics, University of Aberdeen, United Kingdom;
Prof. dr dr h.c. H. (Harald) Schuh, Professor of Satellite Geodesy, TU Berlin and Director of Dept "Geodesy" at GFZ Potsdam, Germany.

A short curriculum vitae of each Committee member is included in Appendix A.

Ir. Sven Laudy of Quicken Management Consultants was appointed as an independent and qualified process consultant to the Committee.

1.3 Impartiality

All Committee members signed a statement of impartiality and confidentiality to ensure that they would assess the quality of the research programmes in an impartial and independent way. Committee members reported any existing personal or working relationships between Committee members and members of the programmes under review before the interviews took place. The Committee discussed these relationships at the first Committee meeting. The Committee concluded that there exist no unacceptable relations or dependencies that could lead to bias in the assessment.

1.4 Data provided to the Committee

The Committee received the following detailed documentation:

- Self-evaluation report of the unit under review, including all the information required by the Strategy Evaluation Protocol 2021-2027 (SEP), with appendices,
- Previous assessment report 2009-2014,
- Additional requested information regarding the relation between the three assessment aspects (Quality of research, Societal relevance and Viability) and the four aspects (Open Science, PhD Policy and Training, Academic Culture and Human Resources Policy) within the Departments,
- Additional requested information regarding the teaching load of research staff.

These documents together with the interviews during site visit formed the Committee's key basis for the assessment.

1.5 Committee Procedures

The Committee followed the Strategy Evaluation Protocol, 2021-2027 (SEP). On March 4, 2022 the secretary of the Committee briefed the Committee on the Strategy Evaluation Protocol for research assessments in an online meeting with the Committee. Prior to the site visit, three assessors were asked to evaluate each programme. These assessors independently formed a preliminary assessment for each programme.

At the start of the site visit, the Committee discussed the preliminary assessments. For each interview, the Committee prepared a number of comments and questions. All Committee members were actively involved in the interviews. After each interview, the Committee discussed comments and recommendations. The Committee spoke with the Rector Magnificus of the TUD and the Dean of the

Faculty of CEG and interviewed the two department heads in the Faculty management team, support staff (HR and Communications) and external stakeholders, and research staff of the two departments. Interviews took place on March 17 and 18, 2021 at the Faculty of CEG in Delft. The interview schedule appears in Appendix B. The Committee chair presented preliminary general impressions to the Faculty on the last day of the visit. Due to the COVID-19 situation, Mr. Droste could not attend the site visit, but he was involved in the preparations of the site visit as well as the final report.

The Committee also discussed a separate request for advice to the Executive Board of the TUD regarding two questions:

1) Does the Committee see opportunities to further strengthen the connection between the GSE and GRS research strategies and multi-disciplinary societal themes, and those of the CEG Faculty?
2) Could the Committee reflect on the current organisational structures of the GSE and GRS Departments?

Following the on-site visit, the Committee finalised the report through email. Final assessments are based on documentation provided by the Faculty, preliminary assessments and interviews. Following approval by all Committee members, the Executive Board received a copy of the first version with the invitation to correct factual errors. In response, the Committee discussed these comments, made several modifications to the text and then presented the final report to the Board of the University. This was printed after formal acceptance.

2 Assessment of the Department of Geoscience and Engineering (GSE)

The mission of the Department of GSE is carrying out research that contributes to: responsible use of the geosphere considering the impact on the earth system and society.

The geosphere is the Earth itself, inclusive of rocks, minerals, soils and landforms; it interacts with the hydrosphere, the biosphere and the atmosphere. Responsible use includes the activities related to exploration and exploitation of natural resources and underground space, and the mitigation of natural and human-induced geo-hazards.

During the review period 2015-2020 GSE focused on the following strategic aims:

1. The department as a single research unit: The aim to be assessed as a single research unit instead of four separate units implied significant changes to the organisation of the department;
2. Strengthening the academic culture: Integration into one unit to address the department culture;
3. Human Resources: Embracing the opportunities offered by the TU Delft tenure-track system implemented at the faculty level allowed to hire excellent new staff and support their career development;
4. Department-wide project portfolio management: Alternative funding sources needed to be found to compensate for the expected decline in one-to-one industry funding in hydrocarbon research;
5. PhD strategy: The department has fully embraced the policy and support of the TU Delft Graduate School aimed at improving the quality of the PhD experience and substantially.

The strategic goals for the next six years are:

- Further development of the interdisciplinary themes
- Installation of a department council
- Improving of academic culture, social cohesion and integrity

- Continue on improving the PhD-strategy
- Prioritizing Open Science
- Improving project and financial management

2.1 Research Quality

The Department of Geoscience and Engineering, GSE, represents an impressive integration of expertise, from fundamental geoscience, investigating underground processes, rock and soil mechanics, to geotechnical engineering, applied geology, applied geophysics and petrophysics, to reservoir engineering.

In the six years under evaluation, GSE has undertaken a major effort to address its research towards the global mission, 'Responsible use of the Geosphere and impact on the Earth System and Society', showing responsibility towards the objectives of the most recent European programmes.

GSE has focussed its research effort towards two main multi-disciplinary themes: a) the Energy transition and b) the Effects of Underground Engineering, which has been a sensible choice, given the background knowledge in geoscience and engineering present in the five sections of the department, on which the progress of the cited research theme activities can be built. Despite the relatively recent launch of the multi-disciplinary Energy transition theme (sustainable energy forms, reduction of carbon emissions, geothermal energy and subsurface energy storage, subsurface storage of CO2), GSE has already acquired a strong reputation, as demonstrated by the significant funding which has been acquired and the large research projects GSE is involved in. Therefore, it is expected that GSE will achieve an internationally leading role in this field.

In the self-assessment report, the presentations of both the Geothermal Energy project and the Offshore engineering project for renewable energy resources have been remarkable. During the visit it could be appreciated that the Geoscience and Engineering laboratory infrastructure is of very high standard.

When wishing to solve complex geoscience engineering problems, there is a need for interdisciplinary analyses. Therefore, the choice was made at departmental level to focus on multi-disciplinary research themes. Nonetheless, during the interviews it could be verified that the researchers are free to carry out research about all the other specialised research topics, aside the multi-disciplinary themes cited above, expressing the several other potential research advancements which are possible, given the expertise present in the department.

The research produced by the Department is of excellent quality, and it is expected to generate even more transfer of knowledge to society, e.g. via (master) students in the future. The quality of the research is reflected in the significant number of peer reviewed publications (871) produced over the review period. The quality and significance of the research activities is also shown by the significant number of important project grants funding the research (e.g. EU ITN EASY GO, WARMING UP, ADMIRE, MIDAS, BLUE PILING, DEEP NL, EPOS-NL Infrastructures, GEOLAB, etc.) and by the several grants awarded to single researchers. However, it is expected that in the next report the merit of the research findings, their use by peers and their impact on good policies and practices will be more dealt with.

GSE realises they are part of a bigger entity, i.e. the Faculty and the TUD, which has always been a site of high standard research production. As soft remark the Committee recommends that GSE goes on making evident the impact of the whole GSE experience [1][1]. A vehicle for this can be the Faculty-wide themes of, e.g. the current challenges of different hazard investigations and within the field of civil engineering.

There was no time to visit the other laboratories of GSE, but it is considered worth providing visibility also to the fundamental research being carried out in GSE and to the other applied research subjects in which TU Delft researchers are involved. Fundamental research and applied research in the more specialized areas will empower the success of the main multi-disciplinary themes which have been selected, since it concerns ground and under-ground properties and

[1] The numbers between the brackets throughout the main text refer to the list of recommendations in the Summary

processes. It is nonetheless comprehensible the current complexity of keeping a balance between all the research activities traditionally under way and the carrying out of very big projects. The effort of investing in huge common projects for the department is considered an honourable challenge. Investing all the resources towards a main big project requires a plan B if the outcome is not as successful as expected.

2.2 Relevance to society

The GSE research objectives are of very high societal relevance since, in general terms, they concern the responsible use and exploitation of natural resources and underground space, and the mitigation of natural and human-induced geo-hazards. Furthermore, in the last 6 years GSE has focused particularly on the energy transition and on the effects of underground engineering, which are recognized as pivotal problems to be solved for the safeguarding of both environment and human health. Furthermore, the fact that global scale environmental damage has become an emergency has impacted the research strategy of GSE, given its past intense collaboration with hydrocarbon industry, even causing an ethical dilemma, which GSE currently has solved.

Given its long tradition in developing methods for exploration and exploitation of hydrocarbon resources, the most logical way forward has been to use GSE knowledge and expertise in geoscience and engineering to develop a research programme dedicated to meet the challenges of the energy transition.

The passing on of research results to society is confirmed by the development of a tight continuous communication with several sectors of society. Also, the societal relevance of the GSE research is confirmed by the size of the funding acquired through research contracts which, excluding EU funding, reached about 21M€ in the 6 year period.

Open Science[2]

An increase in open access publications has been recorded in the six years: open access journal papers increased from 49% to 77%. The general attitude to open transfer of the research data to scientists and society appears to have been strengthened. It is not clear though what barriers remain to keep >20% publications not open access. There seems an excellent commitment to publish experimental datasets openly and to develop a common data reporting standard which would be of great benefit to the community. The support of a data manager is welcomed along with 'data champions'.

Academic Culture[3]

Research integrity awareness was questioned by the previous assessment report which resulted in a questionnaire and the collection of feedback. As a result, the compulsory introduction to Research Integrity for PhD students was launched.

Many other initiatives have been started to improve the academic culture (including openness, safety, inclusiveness and diversity): an Academic Culture Committee (ACC) set up on faculty level, the hiring of a new faculty diversity officer, recruitment for faculty diversity and inclusion team started, *non-violent communication, implicit bias, and active bystander* training, and regulations for complaints at university level.

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[2] GSE software, databases and facilities are used by peers and societal target groups and as such contribute equally to *research quality and societal relevance*. With interdisciplinary research themes, GSE is ready to set up new large projects (like EPOS eNLarge) and form new partnerships. Moreover, information and datamanagement will continue to be important focal points. This all contributes to a *viability*.

[3] Strengthening the academic culture of the department was one of the strategic aims in the review period. Department-wide discussions on the focus and mission, cultural beliefs, and on the ethical dilemmas in working with the hydrocarbon industry, led to a redefinition of the mission, namely that the research should contribute to responsible use of the geosphere considering the impact on the earth system and society. This mission is in line with the Netherlands code of conduct for research integrity. It primarily undergirds *the societal relevance* of the research at the GSE department.

Some younger staff reported to be informed last minute, or faced last-minute changes in their (teaching) schedules), resulting in – avoidable – stress. The Committee recommends to put more effort in formal communication in advance of changes, initiatives, strategies, to mitigate misunderstandings and eventual unhappiness [2]. More informal communication and curiosity towards each other's research may mitigate some social problems, especially of foreign young researchers.

2.3 VIABILITY

The efforts on trying to accommodate everyone and to integrate people in the Department are very convincing. GSE feels like a dynamic Department – with a strong vision of where they want to go – which is moving in the right direction. A lot of research collaboration is developed organically and still the Department is performing well. The Committee also noticed that staff felt really enthusiastic; perhaps this organic way of organising is one reason. New governance structures have been put in place to better engage early career staff/ tenure track staff in Departmental decision making, but for the Committee it is too early to judge success. The Committee noticed there is also some good work on sustainability.

The organic way of organising also has a pitfall: for new staff members, especially for international staff, a more structured approach to developing collaborations is needed, since it is harder for them to get involved in organic, informal ways of cooperating with its implicit and sometimes invisible 'Dutch rules'.

The Department is historically strong in fossil fuel research but has recognised the risk to viability. The Department is not accepting new fossil fuel projects, but is leveraging existing contacts with the fossil fuel industry to work on low carbon, 'green' energy projects. The Committee thinks this is a sensible future strategy, although industry funding for the energy transition so far has been lower. The Committee learned that there is support for academics exploring new funding avenues to replace fossil fuel funding, e.g. a proposal support (research support officer) which is a strong point.

The Committee was impressed by the outstanding experimental facilities, with many unique aspects, and a world-leading, excellent example in geothermal research wells. They were also impressed by the "Open Lab" in which outside partners can make use of the facilities and research infrastructure, which is very inspiring.

The Committee would like to make a soft recommendation regarding the themes, i.e. think about keeping one Theme ("Energy Transition") and define several sub-Themes under this umbrella [3].

2.4 Summary of recommendations

The Committee recommends GSE to:

[1] Continue on making evident the impact of the whole GSE experience, e.g. by collaborating on Faculty-wide challenges of different hazard investigations and within the field of civil engineering;
[2] Put more effort in formal communication in advance of changes, initiatives, strategies, to mitigate misunderstandings and eventual unhappiness among younger staff;
[3] Rethink the themes, i.e. think about keeping one Theme ("Energy Transition") and define several sub-Themes under this umbrella.

3 Assessment of the Department of Geoscience and Remote Sensing (GRS)

In the period 2015-2020 the Geoscience and Remote Sensing programme was given its current shape by integrating the two originally constituting sub-programs Geodesy and Atmosphere. Its mission is 'to understand the interaction between human activities, the Earth system and our living environment through the combination of observational data science and physical modelling'. The GRS programme provides fundamental knowledge for improving our society, as is also reflected in the motto of the CEG Faculty: understand, intervene and improve.

This mission implies crucial elements of the original mission statements of the individual programs:

1. to advance technology and knowledge for monitoring and modelling the Earth and the living environment in space and time;
2. to perform cutting edge research and development aiming at local and regional scales;
3. to develop associated applications in science and society using opportunities offered by new observational platforms and sensors;
4. to contribute to top-level MSc and PhD education.

The 2015-2020 strategic aims are defined at a department, rather than section level to pursue the mission, meeting the collective ambition to deliver high-quality research and education, and benefit society. This requires excellent people (HR policy, PhD Policy and Training), sufficient resources (financial viability) and an effective organisation (Connectivity and Cohesion, Governance and Organisation). Ensuring that research results translate to societal impact requires increasing awareness of our expertise and research (visibility).

The strategic goals for the next six years are:

1. A future proof organisation.
2. Improving the gender balance.

3. An open academic culture.
4. Timely successful PhD completion.
5. Prioritizing Open Science and strategic public outreach
6. Reduce workload by increasing support

3.1 Research Quality

The Committee observed excellent work in most of the research areas, and sometimes even outstanding quality. A high number of peer-reviewed publications with significant international visibility was reported. The impressive number of third-party funded projects (national and international) shows the high quality and competitiveness of the research. The research areas and objectives are overall clear and well-defined.

There could be a stronger internal interaction, for instance between the Geodesy and the Atmosphere themes [4]. Space geodetic techniques (such as GNSS and also others) allow to monitor important atmospheric parameters, that can be relevant for weather forecast but also to climate research. The Ruisdael project is a good example of an national research project carried out with multiple partners across the Netherlands, fitting in the vision of the department.

The scientific relevance of the research results pursued in the 6 years is reflected in the GRS staff visibility: several are editors or members of the editorial boards of leading journals (Table J.8), active in professional organisations and involved in the organisation of international conferences (Table J.9a). GRS staff are actively involved in leading community bodies (e.g. Earth Observation Strategic Plan Netherlands Space Office, IACS - International Association of Cryospheric Sciences, IAG - International Association of Geodesy), also with leadership roles.

The merit of the research products is very well presented. For example, for Geodesy: GRS is founder and global leader of the geodetic theory of mixed-integer estimation; it has introduced an innovative multi-GNSS network calibration method (KP8); it has discovered the mixed-receiver BeiDou Inter Satellite Bias; it

has developed high precision interferometric GNSS; it has developed a terrestrial PNT prototype system, SuperGPS, with atomic time reference distributed to base stations through a fibre-optic network. High quality research members (also according to world's lists) etc. The same applies to Earth Science (Sea level Changes), to Remote Sensing and Atmosphere. The Committee is in particular impressed by the initiating and leading role of GRS members in the Ruysdael Observatory, which is expected to enhance the quality and outreach of atmospheric sciences in the Netherlands even more.

GRS researchers have acquired prestigious grants (also ERC for either starters or consolidators) and they participate to, or lead, large research projects. They also participate in, and lead ESA missions. The Committee noted that many of the prestigious grants were acquired by scientists before they were working at GRS. Apparently GRS was quite successful in attracting these qualified researchers.

3.2 Relevance to society

There is a clear relevance to society on the topics listed. Societal relevance and collaborative projects with societal institutions have been greatly improved compared to the previous assessment (Antarctica case provides a great example). Sustainability is rapidly becoming an important topic, also at TUD level. Also, GRS provides public lectures for a general audience, documentaries for a wide audience and uses traditional and social media for dissemination. Connection to industry is reflected in a good degree of financial and material support provided by companies in research projects.

The Committee recommends to improve the contribution to more operational products that serve the scientific community and also have societal relevance [5]. A concrete example would be risk and hazard analysis. Also, the Committee recommends to set up strategic collaboration with stakeholders to line up long-term activities [6]. Sharing the Department's future vision and goals could be a great means to align the joint activities with the stakeholders. An active outreach

strategy could capitalise better on sharing societally relevant science, especially by younger (PhD & Postdoc) staff [25].

3.3 VIABILITY

The Committee learned that sections are mainly for internal (administrative) use and themes for external profiling and for students. This distinction makes sense and there seems a healthy balance. However, the matrix-system with section and themes system are not yet convincing to the Committee: 1) Using the same term in the sections and themes is adding to the confusion, 2) According to the Committee geodesy is a discipline, not a theme, thus causing redundancy, and 3) Remote sensing is within all sections and is contributing to all themes.

The Committee observed that GRS is also aware of these pitfalls. The Committee feels that choosing one common theme might even improve the collaboration and softly recommends to rethink the section and theme names [7].

The efforts on trying to accommodate everyone and to integrate people in the Department are very convincing. The organic way of organising seems to work well. But it also has a pitfall, as especially for international new staff members a more structural way of collaborating is needed, since it is harder for them to get involved in the organic, informal ways of cooperating with its implicit and sometimes invisible 'Dutch rules'.

The Committee noticed there is also some good work on sustainability.

As a scientifically strong Department with high international visibility GRS could consider to provide more emphasis on operational products to the science community rather than focussing on basic research [8].

Monitoring and predicting risks and natural hazards are not mentioned as a target and should get a stronger focus as it has high societal relevance [9].

The Committee formed the impression that (younger) staff was not always engaged in decision making. However, the setup of new MSc programmes helped in cooperation opportunities, and a broad involvement of staff. This was greatly appreciated by the younger staff, who clearly are looking for more management responsibilities and tasks.

GRS has been successful in attracting excellent talents. The MIT-hiring strategy "quality over niche" with broad job descriptions seems to have worked well. However, this talent policy might be causing an identity problem, when too many staff is hired with a profile of excellence but without alignment or fit with Department's research focus. Thus, next recruitments should be made based on strategic decisions in particular to fill existing gaps in the research portfolio. Examples for important topics that are not covered so far by scientific staff are:

- all four space geodetic techniques (GNSS, SLR, VLBI, DORIS), rather than GNSS only, with special focus on combination of different techniques and various sensors;
- optical and hyperspectral remote sensing.

Open Science[4]

The Committee noticed a strong demonstrated commitment to open sharing of datasets. Good efforts have been made to publish in Open Access journals or article types (> 80%). Given that the Dutch funding authority rules state that all new research must be published in some form of Open Access, one wonders what the reason is that still around 20% of papers is published in closed journals.

The trend in open access journal papers was upward to 2019 but now fixed. The Committee learned - after receiving additional information after the site visit - that a further increase is restricted by the way of accounting rather than a barrier to 100% open access. For example, the registration of articles in PURE, may link to the journal article itself, which may or may not be open access. In that case the

[4] Making science and expertise open to the public attracts students to GRS's educational programmes, which is essential for financial and general *viability*.

article may be disseminated via the TU Delft repository, or similar, but is registered in PURE as published in a non-open access journal.

Academic Culture[5]

Overall the Committee noted an open and friendly attitude among staff members and leadership, and the Committee noted that critical comments are discussed with an open attitude. The faculty-wide strategy discussion organised in 2018 and 2019 as a bottom-up process has led to a well formulated strategy and Appendix 1 of the self-evaluation report shows an excellent overview. The Committee noticed that the bottom-up process has been a very good means to engage all parties. The set-up of the new MSc's by junior staff has been an excellent idea to get them more involved and also to stimulate department wide cooperation. In addition, the pilot scheme for training of staff and new PhD students on communication in a diverse workplace is an excellent idea.

The present distribution of education seems rather ad hoc and the procedures are not felt to be transparent by involved staff. Many expectations are implicit on education (and research). This could be more systematic and homogenised [17]. Being ignorant is frustrating the tenure trackers, the Committee noticed.

[5] GRS is working towards more open and effective communication, and a more inclusive decision-making processes, leading to an effective organisation which essential to deliver *high quality research*. GRS is in a process of revisiting the governance and organisation with a view to creating a future-proof organisation, therefore contributing to the viability of the research unit.

3.4 Summary of recommendations

The Committee recommends GRS to:

[4] Investigate the possibility of building stronger internal interaction, for instance between the Geodesy and the Atmosphere themes;
[5] Improve the contribution to more operational products that serve the scientific community and also have societal relevance;
[6] Keep investing in strategic collaboration with stakeholders to line up long-term activities;
[7] Rethink the section and theme names, as one common theme might even improve the collaboration;
[8] Provide more emphasis on operational products to the science community rather than focussing on basic research;
[9] Get a stronger focus on monitoring and predicting risks and natural hazards.

4 Joint Remarks for GSE and GRS

Although the assessment of the Committee took place on the level of the two Departments, the Committee concluded that several of the observations were valid for both departments. Secondly, by giving joint remarks The Committee hopes it enhances the collaborative spirit – by working side by side on the topics, and may be even on the Faculty level - and eventually will let the two Departments grow further together. Therefore, it was decided to describe the PhD Policy and Training, Outreach, Research versus Education and Human Resources Policy, jointly and differentiate in the text whenever possible.

4.1 PhD Policy and Training[6]

The TU Delft University Graduate School (UGS) and its local branch, the CEG Faculty Graduate School (FGS), provides a structured Doctoral Programme with a PhD Development Cycle, which includes a clear assessment timeline and a course-based Doctoral Education (DE) Programme. It is the ambition of the UGS to facilitate doctoral candidates to become highly qualified, autonomous, and leading researchers and skilled professionals. At TUD, a Doctoral Programme consists of Research and Doctoral Education (DE). The research is embedded in one of the research Departments. The DE Programme is an integral part of the preparation for the doctorate and the graduate's further career. It ensures and enhances the development of scientific quality along with the needed proficiency for interpersonal skills.

The success rates of the PhD candidates at both Departments are found in Appendix E.

[6] For GSE and GRS PhD Policy and Training is essential in order to deliver *high research quality*, this is often done in cooperation with external partners, thus adding to *societal relevance*. The *viability* of the Departments depends on the continued ability to attract and train the best PhD-candidates.

Remarks and recommendations

The Committee noticed that the PhD-candidates seem generally very happy. They report an overall positive onboarding and mentoring experience, although some GRS students suffered from isolation (esp. during COVID), while others didn't seem to be aware of a mentoring scheme and expressed the need for a mentor. The Committee was impressed by the best practices formulated both for PhD students and guiding staff members. PhD-candidates also often experience open door policy. PhD gatherings take place occasionally and are highly valued; the Committee recommends these being organised centrally and on a regular basis [10]. PhD-candidates expressed an uncertainty towards the preparedness for their career after graduation concerning, e.g. writing competitive fellowship applications or practising for job interviews. Although courses are offered on these topics, the Committee suggests to better promote these [11]. It is not always clear to the PhD-candidates how time spent on teaching is accounted for. It is recommended that guidelines regarding the involvement of PhD students in teaching activities are reviewed in line with a general assessment of teaching responsibilities and clearly stated in the PhD policy [12].

There has been a substantial improvement in the finishing times of PhD theses, with most theses recently seem to finish within 5 years. The Committee notes that the rationale behind reducing the graduation time to below 4 years does not always seem to be clear to the PhD candidates, which also relates to the question about what a PhD entails. There seem to be different expectations not only between PhD candidates and supervisors, but also between different supervisors. The Committee applauds the discussion that currently takes place around the different paths that could lead to a PhD and highlights the importance of a clear message towards the students to avoid confusion and frustration.

The Graduate School-system is generally working well and PhD candidates confirm that good practices generally seems to be followed. The support by the Graduate School is appreciated, as is the University Graduate School, in the sense that it offers extra opportunities to interact with students from other disciplines. A PhD council has been installed, and PhD-candidates are being invited to join departmental themes to integrate better in the larger research teams.

A yearly meeting of GS representatives, department heads, and HR takes place concerning the work of supervisors; the outcome of this meeting is reported to the dean. The Committee approves of this as an important instrument to monitor supervision quality.

4.2 Outreach

Outreach is organised at University-level which seems sensible. Different media are used (Twitter, LinkedIn, YouTube-channel, formal press etc.). Training on the job for (classical) media is needed and, especially for the for the younger staff, training in outreach may be needed. The supporting communication department looks very professional and is highly relevant given the very high public interest. The support from the communication office is on an individual basis, e.g. training or coaching. It is left to the researchers if they want to join the public debate. The Committee recommends the preparation of a strategy/ plan at the Faculty on how and when to step in the public debate [13].

A lot of collaboration is taking places with industrial and (non-)governmental bodies. Also, many internal opportunities for collaboration arise, especially in research related to climate change and the energy transition, between GSE and GRS and also with other disciplines within the Faculty CEG, e.g. water management, civil engineering [14]. The overlap may be as much as 50%. The Committee learned that although these are different disciplines, the common mathematical approaches are a good means to work together, as is AI that gives an additional boost to the joint collaboration. The Committee thinks this is good and recommends to further extend these collaborations.

Scientific cooperation with other countries (China, Russia) could be an issue, e.g. regarding risks around IP protection. The Committee noticed that some staff members do not think it is an issue though. This should deserve some attention from the Management [15].

4.3 Research versus Education

The Committee noticed that a "considerable amount of time" is spent on teaching/ education. Since this also influences the time that can be spent on research, the Committee considered education worth investigating. The main conclusions are:

- Time spent on teaching differs greatly between staff members, from not involved in education (mostly parttime full professors) up to 60%. It is not always transparent how much time everyone spends on education although some GRS tenured staff reported an Excel-sheet that gives insight in the numbers to everyone;
- To build in some flexibility to the staff some courses are run with a team of instructors, which gives staff the possibility to spend less or more time on teaching depending on their other tasks;
- The proliferation of MSc and BSc courses is countered with a Dean's "one new course in means one course out"-policy", although according to the Committee, this seemed more of an ideal than a working practice;
- Teaching is seen an important aspect of relevance to society. Regarding the teaching-research nexus: lecturers have their own responsibility to bring in their research into teaching. This is often done as an assignment;
- The Executive Board suggested that it should be the director of education who decides who teaches which course, because quality goes first. The Committee noticed that in practice it is the department head together with the staff who decides, and not the Director of Education. The Committee recommends to investigate this misalignment and create a transparent policy [16].

4.4 Human Resources Policy[7]

Talent management of postdocs

Postdocs have a three year appointment maximum and both Departments benefit significantly from the research that is being conducted by this group. Despite this, postdocs appear poorly integrated into the Department; they are not involved in decision processes and not much is organised to support this group. Postdocs typically don't teach or apply for grants, and are often even discouraged to do so to focus on their research. Some postdocs appreciated this protected research time, while others expressed their wish to add more to the organisation and enhance their skills besides research. While this is not just a problem of the department or TUD, the Committee feels it is a missed opportunity, for both the postdocs and the organisation, that could be addressed, for example, by offering training or mentoring (university teaching qualification, networking opportunities outside academia, etc). This should be in line with the typical requirements for tenure trackers to start preparing postdocs for their next career step.

The Department of GSE is aware of postdocs as a lost group and the Committee appreciates the ongoing discussion of this issue. The Committee learned that one of the ideas was to have a pool of researchers with a 2 times 2.5 years contract. Capacities in this pool can be allocated to different research projects. The Committee considers this idea worth further exploring, hereby taking into account the existing worries about structural funding for this pool.

[7] For the coming period, an aspect of the HR strategy is the hiring of new staff, thus contributing to a *viable* future of the department. Also, the personnel strategy is guided by the fact that excellent people are essential to deliver *high quality research*. The long-term *viability* of the Departments rely on the recruitment of new staff to meet the ambitions in terms of our research portfolio, and the retention and career development of our existing staff.

Talent management of tenure trackers

Tenure trackers seem overall quite happy. The following remarks could make their lives even better.

Many good practices are implicit and in the covid-situation and for foreign staff these implicit rules were more difficult to follow.
The start-up package for tenure trackers was perceived attractive and overall (informal) support is much appreciated. The research environment and facilities were a pull-factor to choose for TU Delft.

The Committee noticed a weak process of onboarding: "everything has to be done at once" without prior experience or having received training.
Guidelines/ documents cannot be found (perceived) and are not clearly written (quality of the written material). Also, expectations of what to expect from tenure trackers is not entirely clear upfront. The Committee recommends to revise the tenure track documents, either by looking for a better document in other departments, or by better tailoring the current document to the GRS and GSE situation [18].
The Committee notices that tenure trackers frequently receive last-minute tasks, causing unnecessary stress. The acquiring of funding is heavy burden, as also has been the contributing to setup of new master. The Committee acknowledges that a high workload is part of the 'job' of tenure trackers, but advices to look into ways of reducing the avoidable stress [19].
At present, tenure trackers seem only little involved in decision making in the departments. GSE is experimenting with a young group of tenure trackers to become part of the MT ("Young MT"). This is a very positive development that deserves following at GRS [20].

To comfort the tenure trackers, the Committee learned that the Faculty of CEG is currently investigation the possibility of being tenured after 1.5 years. The Committee considers this a good step for the tenure trackers. However, in the longer term this could lead to a lowered quality of staff, since people are tenured that would otherwise have left. The Committee recommends the departments to consider this issue and define an 'escape' policy for less qualified staff members to other positions within TUD [21].

Diversity

Diversity has little improved in recent years. There are no systematic efforts to address this and the results are staying behind. The policy to have at least 50% women on the shortlist and 50% of women recruitment is promising, however, gender balance is a major societal issue that is difficult to address, let alone fix, on the department level. It could be worth supporting women already in the department to be a role model for future female scientists (PhD-candidates, students, school pupils) [22]. Here, the Committee acknowledges the efforts that are already being undertaken by engaging with platforms such as "Stories of Science". Moreover, it will be pivotal to consider the behaviour and communication around topics such as childcare, parental leave, or part-time work of both (!) male and female staff, and establish a culture that promotes women in science and enables a healthy work-(family)life balance for all genders.

Regarding diversity with respect to ethnicity and minority groups, the Committee notices awareness for these groups at the Departments – especially the implicit bias staff could have regarding diversity – but recognises little concrete action (yet). The Committee supports ideas to better reflect the local population in students and staff and recommends to give diversity permanent and structural attention [23]. Courses on implicit bias and non-violent communication are appreciated and should be made compulsory and repeated regularly [24].

4.5 Summary of recommendations

The Committee recommends GSE and GRS to:

[10] Organise PhD gatherings centrally and on a regular basis;
[11] Better promote courses to PhD-candidates;
[12] Make existing guidelines regarding the involvement of PhD students in teaching activities, in line with a general assessment of teaching responsibilities and clearly stated in the PhD policy known to the staff and act upon it;

[13] Prepare a strategy/ plan at the Faculty on how and when to step in the public debate.
[14] Further extend collaborations on with industrial and (non-)governmental bodies as well as the Faculty CEG;
[15] Pay attention to the risks of scientific cooperation other countries regarding the protection of Intellectual Property;
[16] Investigate who decides who teaches which course and create a transparent policy;
[17] Present a more systematic and homogenised distribution of education;
[18] Revise the tenure track documents, either by looking for a better document in other departments, or by better tailoring the current document to the GRS and GSE situation;
[19] Look into ways of reducing the avoidable stress for tenure trackers caused by, e.g. last-minute tasks and the acquiring of funding;
[20] Install a Young MT at GRS to improve involvement of young staff;
[21] Consider this issue of early-tenure and define an 'escape' policy for less qualified staff members to other positions within TUD;
[22] Support women already in the department to be a role model for future female scientists (PhD-candidates, students, school pupils);
[23] Give diversity permanent and structural attention;
[24] Make courses on implicit bias and non-violent communication compulsory and repeated regularly;
[25] Work on an active outreach strategy that could capitalise better on sharing societally relevant science, especially by younger (PhD & Postdoc) staff.

5 Executive's Board extra questions

1) *QUESTION 1: "Does the Committee see opportunities to further strengthen the connection between the GSE and GRS research strategies and multi-disciplinary societal themes, and those of the CEG Faculty?"*

From the start, the Committee read this question to mean integration across GSE and GRS, rather than integration with the Faculty. The Committee asked several questions to different panels – including senior staff – and the apparent misinterpretation was not picked up. Consequently, the Committee was not given enough information on Faculty level activities outside of GSE and GRS to make a sound assessment.

The identification of new common research themes, or of links within existing themes, could facilitate new connections. This process could be facilitated from the 'top-down' by, for example, supporting collaborative meetings and workshops, but the collaborations should grow organically from the bottom-up rather than the top-down.

Both Departments could strengthen the connections between their strategies and themes and those of the Faculty: a) Challenges related to water, resources, urbanization etc., 2) Disciplines of monitoring, sensing, data etc., and 3) Development of joint approaches to connect more closely to Faculty priorities could be a route to promote cross-Departmental integration.

2) *QUESTION 2: "COULD THE COMMITTEE REFLECT ON THE CURRENT ORGANISATIONAL STRUCTURES OF THE GSE AND GRS DEPARTMENTS?"*

The formulated themes on Geodesy, Earth System Science, and Atmospheric Science sound overall more appealing than the more traditional names of the sections. Also Remote Sensing (as an observational methodology) has some overlap with the subjects of the other themes within GRS and also with the Water Management department.

Given the mission of GRS on the Earth system and living environment using both observational data science and physical modelling, one may consider renaming GRS. Would "Earth system science and engineering" not be a better fit for the name of the department (also given the figure in Appendix 1)?

GSE was formed from four research units into one department with a common strategy and mission. On basis of 5 more traditional disciplines, two more appealing multi-disciplinary themes are developed. The use of 'Geo-Engineering' for a section name is rather confusing, while in fact soil engineering is focussed on in that section. Moreover, 'Geo-Engineering' is typically used for methods which aim to modify the earth radiation balance to counter global warming.

Conclusion: cherish, involve and train your talents

Geosciences at TU Delft is at the forefront of scientific research. The Departments have been able to change directions towards highly societally relevant research topics of climate change and energy transition. The Departments have a very well-equipped infrastructure and facilities, a healthy financial situation and outstanding young as well as senior research staff. Also, it has been able to recruit excellent new staff. This staff – especially the young generation – could be even more cherished, involved in management and trained to make them flourish *and* happy.

Hardware like the organisational (matrix) structure, the themes, HR policies, strategies on outreach, monitoring educational load etc. etc. could all be fine-tuned, but the Committee would like to stress that it is the software, the people that make the difference – bottom-line: the organisation is only a vehicle to have people collaborate and interact with each other and make them flourish.

With these conditions set, the Committee thinks Geosciences is ready for the journey.

Appendix A Curricula vitae of the Committee members

Ir. H.C. (Hetty) Klavers, Committee Chair, obtained a master's degree Applied Mathematics at University of Twente in Enschede (NL) in 1989. From 1989 till 2009 she worked at the Directorate-General for Public Works and Water Management ('Rijkswaterstaat'). She started as mathematical researcher; a variety of positions followed. Her last appointment at Rijkswaterstaat was director of the national networks of roads, water systems and waterways.
From 2009 to 2013 she lead an intergovernmental and multi-stakeholder program called 'Delta-program IJsselmeer-region'. This program developed an adaptive strategy to cope with the vulnerability of the region to the effects climate change.
In 2013 she was appointed chair of one of the 21 the regional water authorities in the Netherlands, named 'Zuiderzeeland'. Zuiderzeeland consist mainly of three large polders that were designed by engineer Cornelis Lely, one of the first students at Delft University of Technology. The water authority is a democratic governing body that is responsible for flood protection, waste water treatment, water quality management and preventing droughts or water surpluses. The position of chair is comparable to a mayor.
She holds several additional positions. She serves e.g. as vice president of the supervisory board of drinking water company 'OASEN', as member of the Advisory Committee to the Minister of Economic affairs and Climate on Mining, and as member of board of the international 'IJsselbiënnale'.

Prof. dr F. (Federica) Cotecchia is a full professor in Geotechnical Engineering at Politecnico di Bari (PoliBA). She received her PhD in Soil Mechanics at Imperial College of London in 1996. From 2013-2019 she was a delegate of the Rector for the Quality Assessment of Teaching and Research at PoliBA within the evaluation framework issued by the Ministry of University. She is also Scientific Responsible of the Geotechnical Laboratory of PoliBA. From 2001-2003 Federica was a delegate of the Rector for the International Relations of PoliBA. Federica has conducted experimental research, in the laboratory and the field, and endeavoured the development of theoretical frameworks of hydro-mechanical

behaviour of soils and of geotechnical systems. Her work has conveyed knowledge about the influence of micro to meso structure on the behaviour of clays, under either full or partial saturation, in relation to their geological history, of reference for several elasto-plastic hardening constitutive models. With regard to geotechnical systems, she has mostly developed research about the geo-hydro-mechanical modelling of complex natural deposits, in either mountainous areas, or alluvial planes, the mechanics of slopes and landslides, the effects of geotechnical settlements on either ancient or modern structures, the response of contaminated marine sediment deposits. She has studied the processes generating different landslide mechanisms, implementing advanced soil mechanics in the assessment of landslide hazard at the site scale (work subsidized also by MIUR funding). In a recent 'Strategic Project', subsidized by European funds (selection on behalf of Apulia Region), under her coordination the research has resulted in a multi-scalar method for the assessment of landslide hazard based upon geo-hydro-mechanical analyses. She is currently doing research heading towards a framework of geo-hydro-mechanical characterization of landslide classes and on landslide risk sustainable mitigation (drainage systems and smart vegetation). She is author of 176 papers, published, after peer review, in international scientific journals, books and proceedings. On March 28th, Scopus quotes for her: 1366 total citations and HI 20. She has been and currently is PI of several national and international research grants. She has successfully tutored so far 12 Philosophy Doctors in Geotechnical Engineering and is currently tutoring 4 PhD students.

Dr A.M. (Arjan) Droste obtained an MSc degree in Earth & Environment, specialising in Meteorology, at Wageningen University (The Netherlands) in 2015. He subsequently obtained his PhD degree in Urban Meteorology at Wageningen University in 2020, followed by a post-doc at the Hydrology & Quantitative Water Management group in Wageningen, on opportunistic sensing of rainfall in developing countries using cellphone tower data. Currently he works as an emissions scientist at the Netherlands Organisation for Applied Scientific Research (TNO). He is a member of the European Geosciences Union (EGU) and the European meteorological Society (EMS). His research interests are focused on urban hydrometeorology, including how wind speeds are changed by urban areas and can form local 'urban wind islands', as well as a special focus on

the use of unorthodox measurement techniques such as smartphones and private weather stations to gather hydrometeorological data in data-sparse regions (cities as well as developing countries).

Em. prof. dr A.A.M. (Bert) Holtslag received a BSc in Technical Physics with the University of Applied Sciences, Enschede (NL) in 1976, and a PhD degree in Meteorology at Wageningen University (NL) in 1987. He was employed by the Royal Netherlands Meteorological Institute (KNMI) in various research positions (period 1977-1999) and by the Institute for Marine and Atmospheric Research at Utrecht University (1993-1999) as (part-time) professor of Meteorology. Subsequently, he served as Professor of Meteorology and Chair at the Meteorology and Air Quality Section at Wageningen University (1999-2019). His honours include a fellowship of the American Meteorological Society (AMS), the Sergej Zilitinkevich Memorial Award for breakthrough research in atmospheric sciences and recently he was given the 'Langerhuizen Oeuvre' award for Earth and Environmental Sciences. Under his direction so far 46 students finished their PhD. He has a large track record in research and leadership of programs dealing with modelling and process studies for weather, air quality and climate, including atmosphere-land interactions, surface fluxes, boundary-layer processes, wind energy and urban meteorology. Currently he is President of the European Meteorological Society (EMS), member of the Supervisory Board of KNMI and member of an International Advisory Committee with the National Center for Atmospheric Research (NCAR), Boulder, CO.

Prof. dr M.D. (Matt) Jackson holds a BSc in Physics from Imperial College London and a PhD in Geological Fluid Mechanics from the University of Liverpool, where he focussed on the fluid mechanics of magmatic systems with application to the processes forming large granite bodies in the Earth's crust. He (re-) joined Imperial College as a post-doc in the Department of Earth Resources Engineering, which later merged with the Department of Geology to form the current Department of Earth Science and Engineering. He has remained in the department since joining. Currently he is Professor in Geological Fluid Mechanics, Director of Research and leads the Novel Reservoir Modelling and Simulation (NORMS) group, a multi-disciplinary collective of geoscientists, applied mathematicians, engineers, and experimental and computational physicists. The group develops and applies new methods to monitor and model fluid flow and

transport in subsurface reservoirs and aquifers. Applications of the research are numerous and include monitoring and modelling of groundwater flow and contaminant transport, exploitation of essential metals for the energy transition, subsurface energy storage, geothermal resources and magma reservoir processes. Matt leads several large, cross-disciplinary projects on these topics, funding by the UK research councils, the EU, and industry. He is currently a member of EAGE, EGU and AGU. He has received the 2015 Norman Falcon Award and the 2022 Albert Wegener Award of the EAGE, the 2013 Sproule Memorial Certificate of the AAPG, the 2011 SPE European Region Outstanding Achievement Award, and served as a Distinguished Lecturer of the AAPG.

Dr K. (Katrin) Löer is a Lecturer in Environmental Seismology at the Department of Geology and Geophysics of the University of Aberdeen, UK, since 2020. She studied Geophysics at the University of Münster, Germany, before completing her PhD on "Source-receiver wavefield interferometry in scattering media" at the University of Edinburgh, UK, in 2015. In 2016, she secured a grant from the German Research Foundation (DFG) that allowed her to work as a postdoctoral researcher at Bochum University of Applied Sciences, Germany, on "Synthesis of passive seismic methods for geothermal applications". From 2016 to 2020, she was a member of the EU's Horizon 2020 project "GEMex", an interdisciplinary and international collaboration investigating geothermal sites in Mexico. She's a member of the German Geophysical Society (DGG) and the European Geosciences Union (EGU). Her research interests include linking conventional and non-conventional seismic methods (such as beamforming and seismic interferometry), improving their computational performance, and thereby reducing experimental costs for subsurface characterisation related to renewable energy targets.

Prof. dr dr h.c. H. (Harald) Schuh studied geodesy at the University of Bonn where he was awarded a PhD degree in 1986. He was Associate Professor at the Geodetic Institute of the University of Bonn (1987-1988) and Program Scientist at the German Air and Space Agency in Cologne (1989-1995). From 1995 till 2000 he was Head of Dept. "Earth Rotation" at the German Geodetic Research Institute in Munich. In 2000 he was appointed as Full Professor for Higher Geodesy at Vienna University of Technology where in 2003 he became Director of

the Institute of Geodesy and Geophysics. Since 2012 he is Chair of Satellite Geodesy at Technische Universität Berlin and Director of the Department Geodesy at Helmholtz-Centre Potsdam - GFZ German Research Centre for Geosciences. His honors include: the Descartes Prize of the European Union (2003), Fellow of the International Association of Geodesy (IAG), Doctor honoris causa of the University of Architecture, Civil Engineering, and Geodesy in Sofia (2009), and the Vening Meinesz Medal of the European Geosciences Union (2011). Among many duties and positions in national and international organisations he was President of the IAG (2015-2019) and became Chair of the German Geodetic Commission in 2019. His research interests include: Space geodesy, Very Long Baseline Interferometry, Global Navigation Satellite Systems, troposphere, ionosphere, Earth rotation, and interactions in the system Earth.

APPENDIX B SITE VISIT PROGRAMME

DAY 0 – Wednesday March 16, 2022		
Time	**Activity**	**Participants**
17.30	Arrival of Committee	Committee (private)
18.00	Working dinner: kick-off & preparation	Committee (private)
21.30	Closure	

DAY 1 – Thursday March 17, 2022		
Time	**Activity / Assessors**	**Participants**
8.30 – 9.00	Preparation of interviews	Committee (private)
9.00 – 9.30	Welcome Committee by Rector and interview Executive Board	Tim van der Hagen (Rector Magnificus & President EB) Jan Dirk Jansen (Dean CITG)
9.30 – 9.45	Reflection	Committee (private)
9.45 – 10.30	Interview Management Team	Jan Dirk Jansen (Dean CITG) Timo Heimovaara (Chair GSE) Herman Russchenberg (Chair GRS)
10.30 – 11.00	Reflection / Break	Committee (private)
11.00 – 11.45	Interview Geoscience & Remote Sensing	Ramon Hanssen Roland Klees Herman Russchenberg Susan Steele Dunne Pier Siebesma Peter Teunissen Bas van der Wiel
11.45 – 12.00	Reflection	Committee (private)
12.00 – 12.45	Interview Geoscience & Engineering	Timo Heimovaara Femke Vossepoel Michael Hicks Joep Storms Kees Wapenaar Mike Buxton Pacelli Zitha
12.45 – 13.00	Reflection	Committee (private)
13.00 – 13.45	Lunch with PhD's and Postdocs	*Post-doctoral Researcher:* - Maartje Boon (GSE) - Divya Varkey (GSE)

		- Jose Dias Neto (GRS) - Antoon van Hooft (GRS) *PhD candidates:* - Hamed Diab Montero (GSE) - Aoxi Zhang (GSE) - Parvin Kolah Kaj (GSE) - Jeroen van Duijvenbode (GSE) - Florencia Balestrini (GSE) - Mieke Kuschnerus (GRS), - Philp Conroy (GRS), - Sophie de Rooda (GRS), - Inger van de Vaate (GRS) - Sebastian Ciuban (GRS)
13.45 – 14.00	Reflection	Committee (private)
14.00 – 15.00	Lab Tour I - GRS	*Postdocs & researchers:* - Freek van Leijen - Sotiria Georgiou *PhD candidates*: - Lotfi Massarweh - Yosra Afrasteh - Andreas Theodosiou -Mieke Kuschnerus - Alessandro Savazzi - Felix Dahle - Maaike Izeboud - Judith Boekee - Yi Dai - Jose Dias Neto - Mariska Koning
15.00 – 15.15	Reflection	
15.15 – 15.45	Interview Tenure trackers - GRS	Franziska Glassmeier Marc Schleiss Bert Wouters
15.45 – 16.15	Reflection / Break	Committee (private)
16.15 – 17.15	Lab Tour II - GSE	Phil Vardon Hadi Hajibeygi Auke Barnhoorn Federico Pisanò
17.15-17.45	Interview Tenure trackers – GSE	Alexandros Daniilidis Guillaume Rongier Masoud Soleymani Shisvan Pierre-Olivier Bruna Stefano Muraro

17.45 – 18.00	Reflection	Committee (private)
18.00 – 18.30	Interview HR Policy. Including: - Diversity & Inclusion - Rewards & Recognition, - Talent development, - Leadership profiles, - Career committee (VLC)	Maaike Jonker Evert Slob Giovanni Bertotti Susan Steele Dunne
19.00	Refreshing at hotel	Committee (private)
19.30	Working dinner: discussing and writing preliminary judgments	Committee (private)
21.30	Closure	

DAY 2- Friday March 18, 2022		
Time	**Activity / Assessors**	**Participants**
8.30 - 9.00	Preparation interviews Committee	Committee (private)
9.00 – 9.30	Interview Tenured staff (GSE)	Ken Gavin Denis Voskov Anne-Catherine Dieudonné, Deyan Draganov Hemmo Abels Annemarie Muntendam-Bos
9.30 - 9.45	Reflection	Committee (private)
9.45 - 10.15	Interview Tenured staff (GRS)	Louise Nuijens Paco Lopez Dekker Sandra Verhagen Roderik Lindenbergh Cornelis Slobbe Miren Vizcaino
10.15 – 10.45	Reflection / Break	Committee (private)
10.45 – 11.15	Interview Communication Strategy	Yvon van der Meer Herman Russchenberg Stef Lhermitte Phil Vardon Hadi Hajibeygi
11.15 – 11.30	Reflection	Committee (private)
11.30 - 12.00	Interview stakeholders (application-orientated co-creating research)	Gerard van der Steenhoven, KNMI Roger Haagmans, ESA Jorien Schaaf, EBN Läslo Evers, GSE/KNMI Wim Mulder, GSE/Shell Bert Vermeersen, GRS, LR / NIOZ
12.00 – 12.15	Reflection	

12.15 - 12.45	Interview PhD Policy	Giovanni Berttoti (Dir. GS) Bas van de Wiel (GRS) Timo Heimovaara (GSE) Ilse Oonk (Coord. GS) Mariska Koning (PhD GRS) David Naranjo Hernandez (PhD GSE)
12.45 – 13.45	Summarizing findings and first conclusions (including lunch)	Committee (private)
13.45 – 14.15	Concluding meeting with management	Jan Dirk Jansen (Dean CITG) Timo Heimovaara (Chair GSE) Herman Russchenberg (Chair GRS)
14.15 – 15.00	Discussing and writing preliminary judgments	Committee (private)
15.00 – 15.30	Preparation of presentation	Chair + secretary
15.30 – 16.00	Oral presentation on first impression by Committee	Committee
	Closure	Refreshments with Committee and Faculty
	Follow up meeting Chair + secretary	Chair + secretary

APPENDIX C SEP-DATA ON RESEARCH STAFF

	2015		2016		2017		2018		2019		2020	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Assistant professor	13	11.4	13	11.2	15	12.1	16	12.1	16	11.2	16	13.1
Associate professor	10	7.1	12	8.9	13	10.5	14	10.8	17	13.6	17	13.4
Full professor	15	10.8	16	10.6	16	10.9	16	10.1	15	10	15	9.8
Researchers	60	27.3	60	29.4	57	31.8	58	36.3	58	35.4	63	39.4
PhD candidate	108	77.6	105	84.8	105	86.8	103	85.2	101	84.2	96	85.3
Total research staff	**206**	**134.2**	**206**	**144.8**	**206**	**151.9**	**207**	**154.6**	**207**	**154.3**	**207**	**161.2**
Support staff	9	7.3	7	6.1	6	5.2	6	4.8	5	3.4	7	5.2
Total staff	**215**	**141.5**	**213**	**150.9**	**212**	**157.1**	**213**	**159.3**	**212**	**157.7**	**214**	**166.4**

Table 1: Staff embedded in the GSE department

	2015		2016		2017		2018		2019		2020	
	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE	#	FTE
Assistant professor	10	9.4	10	8.4	11	10.4	10	8.2	12	9.3	13	10.4
Associate professor	4	2.6	6	3.9	5	4.2	6	5.2	6	5.2	6	5.2
Full professor	8	4.5	8	4	9	5.6	9	5.6	9	5.6	9	6.4
Researchers	36	21.0	39	20.7	39	18.2	42	15.0	48	21.6	43	26.6
PhD candidate	57	37.4	57	33.7	59	33.0	55	31.5	51	31.0	52	32.5
Total research staff	**115**	**74.9**	**120**	**70.7**	**123**	**71.4**	**122**	**65.5**	**126**	**72.7**	**123**	**81.1**
Support staff	-	-	-	-	-	-	-	-	-	-	-	-
Total staff	**115**	**78.0**	**120**	**74.1**	**123**	**74.8**	**122**	**68.9**	**126**	**75.9**	**123**	**84.4**

Table 2: Staff embedded in the GRS department

APPENDIX D SEP-DATA ON RESEARCH FUNDING

	2015		2016		2017		2018		2019		2020	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding[1]	4487	31%	4352	35%	4564	37%	4289	39%	4539	31%	5373	43%
Research funding[2]	1328	9%	1379	11%	1129	9%	1082	10%	1662	11%	2265	18%
Contract research[3]	8281	57%	6127	50%	6202	51%	5239	48%	8264	57%	4685	37%
Other[4]	426	3%	434	4%	299	2%	274	3%	152	1%	241	2%
Total funding	**14523**	**100%**	**12292**	**100%**	**12195**	**100%**	**10884**	**100%**	**14616**	**100%**	**12564**	**100%**

Table 3: Total funding at level of the GSE department. All amounts in k€.

TOTAL	2015		2016		2017		2018		2019		2020	
	k€	%	k€	%	k€	%	k€	%	k€	%	k€	%
Direct funding[1]	2721	55%	2590	53%	2859	54%	2675	48%	2762	32%	3210	40%
Research funding[2]	660	13%	772	16%	469	9%	661	12%	1920	22%	2422	31%
Contract research[3]	1557	31%	1500	31%	1978	37%	2121	38%	3825	45%	2254	28%
Other[4]	35	1%	49	1%	-19	0%	88	2%	69	1%	87	1%
Total funding	**4973**	**100%**	**4911**	**100%**	**5287**	**100%**	**5545**	**100%**	**8576**	**100%**	**7995**	**100%**

Table 4: Total funding at level of the GRS department. All amounts in k€.

1 Direct funding by the University, obtained directly from the University, and the financial compensation for educational efforts.
2 Research funding obtained in national and international scientific competition (e.g. grants from NWO, KNAW, ESF).
3 Research contracts for specific research projects obtained from external organisations, such as industry, governmental ministries, European Commission, charity organisations, and ERC.
4 Funds that do not fit into the other categories.

APPENDIX E SEP-DATA ON PHD CANDIDATES

Enrolment (#)				Success rates (%)						
Starting year	**Male**	**Female**	**Total (male + female)**	**<= 4 years**	**<= 5 years**	**<= 6 years**	**<= 7 years**	**# Total**	**Not yet finished**	**Discontinued**
2012	11	2	13	0%	46%	85%	92%	12	8%	0%
2013	8	5	13	15%	62%	69%	100%	13	0%	0%
2014	10	2	12	8%	58%	83%	83%	10	0%	17%
2015	16	4	20	15%	85%	85%	85%	17	10%	5%
2016	11	2	13	8%	38%	38%	38%	5	54%	8%
Total	**56**	**15**	**71**	**10%**	**61%**	**73%**	**80%**	**57**	**14%**	**6%**

Table 5: Success rates of the PhD candidates at the Department of GSE. Note: This table only includes Standard PhD candidates (with employee status) and Contract PhD candidates (without employee status, receiving external funding) conducting research with the primary aim/obligation of graduating, based on a 0.8-1.0 FTE contract.

Enrolment (#)				Success rates (%)						
Starting year	**Male**	**Female**	**Total (male + female)**	**<= 4 years**	**<= 5 years**	**<= 6 years**	**<= 7 years**	**# Total**	**Not yet finished**	**Discontinued**
2012	8	2	10	10%	30%	70%	80%	8	10%	10%
2013	6	1	7	0%	43%	43%	57%	4	14%	29%
2014	2	2	4	0%	50%	100%	100%	4	0%	0%
2015	6	1	7	0%	29%	29%	29%	2	57%	14%
2016	3	2	5	20%	20%	20%	20%	1	60%	20%
Total	**25**	**8**	**33**	**6%**	**33%**	**52%**	**58%**	**19**	**27%**	15%

Table 6: Success rates of the PhD candidates at the Department of GRS. Note: This table only includes Standard PhD candidates (with employee status) and Contract PhD candidates (without employee status, receiving external funding) conducting research with the primary aim/obligation of graduating, based on a 0.8-1.0 FTE contract.

Quicken ORGANISATIE ADVISEURS

bureau voor organisatieontwikkeling