Evaluation of the National User Support Programme Space Research 2017 – 2019

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Management summary

The GO evaluation: goal and scope

The National User Support Programme Space Research (Nationaal Programma Gebruikersondersteuning Ruimteonderzoek, or GO programme) is a funding scheme to support researchers working in the Netherlands with the use of scientific infrastructure in space for the purpose of high-quality research. The programme is open for research in the areas of Earth observation and solar-system planets. Both themes are scientific priorities in the current national space policy. The programme is funded by the Dutch Ministry of Education, Culture and Science (OCW), and is part of the Dutch space policy. The Dutch Research Council (NWO) bears the final responsibility for the programme, while the Netherlands Space Office (NSO) is responsible for its execution and day-to-day management.

The Ministry of OCW, NWO and NSO highly valued an independent evaluation of the GO programme 2017 – 2019 to come to a good substantiation and implementation of a possible follow-up programme. Over this past period, three annual subsidy rounds were held with a budget of M€ 2.4 per year. These rounds funded an average of 10 projects per year, which is about 24% of the applications submitted to the programme.
NWO appointed an external and independent committee to conduct the evaluation. The primary goal of the committee's work was to assess the relevance and effectiveness of the GO programme. The evaluation questions cover 1) the programmatic aspects, 2) the assessment of the scientific and substantive results, and 3) the implementation aspects of the GO programme. The committee performed their task in the period October 2020 to June 2021. Their evaluation methods comprised the use of various documents as background information and of statistical data about the GO programme in the past years. Furthermore, written input from the Dutch Earth observation and planetary science community was collected, and a questionnaire was sent to project leaders of approved GO projects to request information about the present career status of (former) PhD students and postdocs hired by the GO projects. The committee also conducted interviews with a handful of persons related to 1) planetary research under the GO programme and 2) policy aspects of the GO programme.

Main conclusions

The overall and unanimous conclusion of the evaluation committee is that the GO programme covers a unique niche, also internationally, and the committee strongly recommends the programme be continued. In the committee's view, the GO programme consolidates the international position of Dutch space research in Earth observation and planetary science, and stimulates further development of and spinoff to societal applications. The committee concludes that the GO programme has no equal in Europe in terms of offering similar support to Dutch researchers.

As for the programmatic aspects, the committee finds that the GO programme is well aligned with one of the main goals of Dutch space policy, viz. '*maximizing the societal, scientific and economic relevance of space for the Netherlands*'. Considering that the use of data generated by space infrastructure is becoming more and more relevant in a scientific and societal context, the committee also concludes that the GO-targeted funding is and remains necessary at – at least – the same level. Since the focus of the GO programme is not related to a single discipline but aimed at encouraging the use of space data infrastructure, the committee considers it very important to have a clear specification of what type of research the programme covers, and what it does not cover.

The committee concludes that the GO programme has enabled research projects that have led to high-quality and diverse scientific results in both Earth observation and planetary science. GO-funded projects from both these themes have already demonstrated they can have a broad scientific and societal impact. The committee therefore recommends that both thematic priorities should be preserved in a possible future GO programme. Looking back at the period 2017 – 2019 , in which no proposal from planetary science received GO funding, the committee notes that it is important to keep paying attention to inherent differences between the science areas covered by the programme to ensure a level playing field.

In general, the committee is satisfied by the way the GO programme is implemented and executed in practice. The committee concludes that the efficiency of the procedure is appropriate for this kind of funding programme, but that – in view of the typical number of applications (around 40 each Call) and a funding rate of about 25% –

an alternative with pre-proposals can be considered. Secondly, the committee remarks that mid-term and final reports by the GO lead researchers are somewhat less used by the programme coordinator than may be desirable to control the progress and results of the research project. With regards to '*the composition and role of the assessment committee',* the committee concludes that their role is clear; the committee found no reason to doubt that the members of the subsequent committees carefully and with integrity fulfilled their responsibilities. A plausible explanation for the zero funding rates of planetary science proposals between 2017 – 2019 is a combination of 1) the overall low number of planetary science applications and 2) the effect of implementing the '*extent of use of space infrastructure*' as one of the assessment criteria in the years 2017 and 2018 instead of an eligibility criterion as in other years. In the opinion of the committee, the 2019 Call created a more level playing field for Earth observation and planetary science as the second point was reverted in the 2019 Call.

Recommendations

Despite of their – in general – positive findings, the committee recommends the following rather straightforward improvements in the GO programme, based on the conclusions given above:

1. The niche of the GO programme needs a better specification that stresses the main goals to:
    a. put down the foundation for new satellite missions/instrumentation based on modelling, calibration, or validation of data from space data infrastructure;
    b. use new levels of advanced data analyses for existing, past and future space infrastructure.

2. In light of recommendation 1, the committee recommends a different name for the programme: '*Scientific Use of Space Data Infrastructure Programme'* (in Dutch: '*Programma Wetenschappelijke Gebruikersondersteuning Ruimtevaartgegevensinfrastructuur*') with the acronym 'WeGO'.

3. Both current research themes, Earth observation and planetary research, should be continued. If the PEPSci programme is discontinued, the addition of exoplanetary research could be considered for the future.

4. To ensure that there is no disbalance between the thematic priorities of the GO programme, it is recommended to fund at least one proposal of each theme in each Call (provided that it meets the minimum qualification criteria).

5. The committee recommends that the focus of the GO programme remain on scientific knowledge development and exploration of applications to allow the results of this scientific research to make a broad impact.

6. It is recommended to maintain at least the present level of funding for the GO programme. Given its success in the past as well as the present development of growing societal demands, an increased level of funding should be considered.

7. Regarding programme implementation aspects the following recommendations are made:
    a. To ensure a level playing field for both Earth observation and planetary applications, the extent of use of space infrastructure is not to be used as an assessment criterion, but should remain an eligibility criterion.
    b. More explanation is needed on the issue of knowledge utilization (to applicants and assessment committee) to weigh this aspect better in the assessment. A weight of 12.5% (not less) for the knowledge utilization criterion is appropriate given the programme's emphasis on scientific research.
    c. The visibility of the results of GO projects can be improved by asking applicants to indicate in the proposal whether it fits in national policy areas, what kind of attention in the media is expected during the course of the work and what possibilities are foreseen for use by governmental agencies or companies.
    d. In order to make the assessment procedure more efficient, it is recommended to consider a two-phase approach with pre-proposals and full proposals. The advice to submit a full proposal or not can be binding or non-binding.
    e. It is recommended to continue requesting mid-term and final reports from the approved projects to have more grip on the progress and results of the subsidized research.

1 – Introduction

The National User Support Programme Space Research (Nationaal Programma Gebruikersondersteuning Ruimteonderzoek, or GO programme) is a funding scheme to provide support to researchers working in the Netherlands with the use of scientific infrastructure in space for the purpose of high-quality research, or the preparation thereof. The programme is open for research in the areas of Earth observation and solar-system planets (1). Both themes are scientific priorities in the current Dutch space policy. The programme is funded by the Dutch Ministry of Education, Culture and Science (OCW), and is part of the Dutch space policy. Encouraging the use of space infrastructure for the benefit of science and society is a priority within this policy. The Dutch Research Council (NWO) and the Netherlands Space Office (NSO) cooperate in the GO programme: NSO is responsible for its realization and day-to-day management, whereas the NWO Domain Science Board bears the final responsibility.
The GO programme has a long history: it started in 1993 as part of the Dutch Earth observation policy. The current GO programme was launched in 2007 and was financed in three tranches: 2007 – 2011, 2012 – 2016, and 2017 – 2019. For the final tranche a total budget of M€ 7.2 was available, from which three annual GO rounds were financed. Each of the first two tranches were evaluated after completion, but contrary to the previous tranches the 2017 – 2019 tranche does not include a formal evaluation obligation. Nevertheless, the Ministry of OCW, NWO and NSO attach great importance to an independent evaluation in order to ensure the programme's relevance and effectiveness, and to come to a good substantiation and further implementation of a possible follow-up programme. For the time being, budget to continue the GO programme in 2020 – 2022 has been reserved in the national space budget, based in part on the NSO Space Policy Advice (2).

1.1 Goal, scope and stakeholders of the evaluation

The goal and scope of the evaluation, as well as the assignment for the evaluation committee, were laid down in the Terms of Reference. The primary goal of the evaluation of the GO programme is to assess its relevance and effectiveness. The evaluation questions pertain to 1) the programmatic aspects, 2) the assessment of the scientific and substantive results, and 3) the implementation aspects (see Appendix A for details). The evaluation committee was also asked to make recommendations for the future. The evaluation of the GO programme's 2017 – 2019 tranche is one of several evaluations started in 2020[1] that relate to Dutch space research and space policy, and that will inform the Dutch government when considering the national space policy for future years. The envisioned stakeholders of this evaluation are scientists (leaders of GO projects, potential submitters of GO proposals, members of the GO assessment committees) and science- and space-policy makers (Board of Directors of Research and Science Policy of the Ministry of OCW, NWO Domain Science Board, the NSO steering group).

1.2 The GO programme in 2017 – 2019

The goals and implementation of the GO programme in the period 2017 – 2019 (see Appendix B for details), were largely similar compared to the previous tranche, except for a few noteworthy changes:

1. Starting in 2017, the primary condition that GO proposals should make '*active*' or '*direct and substantial*'[2] use of (data from) existing or planned space infrastructure (the 'GO condition'), was more strictly enforced.
2. In the GO rounds of 2017 and 2018, the '*extent of use of space infrastructure*' was one of the assessment criteria to be judged by external referees and the assessment committee, rather than an eligibility criterion assessed by the NSO bureau as was the case in the period 2012 – 2016.
3. In the GO round of 2019, this was reversed and the '*extent of use of space infrastructure*' again became part of the eligibility check performed by NSO.
4. In the GO round of 2018, researchers could apply for an in-kind contribution in the form of an eScience research engineer employed by the Netherlands eScience Center (NLeSC) to contribute to the (Big) data handling and analytics, and computing aspects of the project.

The potential impact of these changes was carefully considered by the committee.

[1] The other evaluations concern space research in the Netherlands (9), the Instrument Development Programme and the Partnerships for Space Instruments & Applications Preparatory Programme (11), and an exploration of the added value of the Dutch space sector for the Netherlands (10).
[2] The term «active» was used in the 2017 GO Call for proposals; the terms «direct and substantial» were used starting from the 2018 Call, and were clarified in the 2019 Call.

In the period 2017 – 2019, the GO programme supported an average of 10 projects per year, with an average funding rate of 24% of the submitted proposals. These numbers are very similar compared to the 2012 – 2016 tranche. Differences become apparent when considering Earth observation and planetary science proposals separately: in 2017 – 2019 the funding rates for each discipline were 22 – 39% and 0%, respectively, whereas in 2012 – 2016 the rates were 16 – 42% and 10 – 50%, respectively. The number of planetary proposals is small: in 2017 – 2019, 9 – 15% (typically 5 of 40) of the proposals came from planetary science, a drop from 16 – 30% in the years 2012 – 2016 (see Appendix C for details).

1.3 Evaluation committee

The NWO Domain Science Board installed an external and independent committee to conduct the evaluation. The composition of the committee is as follows:

Drs. Mirjam Bartels (Geo Data & IT, TNO, Netherlands)
Prof. dr. Doris Breuer (Institute of Planetary Research, DLR, Germany)
Dr. ir. Frits Brouwer (former KNMI, Netherlands) – vice-chair
Drs. Steven Krekels (VITO Remote Sensing, Belgium)
Dr. Catherine Prigent (LERMA/CNRS, France)
Prof. dr. ir. Tom Veldkamp (Twente University, Netherlands) – chair

On behalf of NSO, Dr. Jennifer Grant and Drs. Daniëlle Hollman were involved in the preparation of the evaluation. During the evaluation, Drs. Hollman, being directly involved in the execution of the GO programme, prepared information about the programme when the evaluation committee requested it, and provided administrative support. Dr. Maureen van den Berg (NWO) acted as secretary of the committee. The committee formally started their activities in mid-October 2020 but could only meet on-line. Due to the hack of its servers, NWO was temporarily shut down in February/March 2021 (3), and as a result the evaluation experienced some delay.

1.4 Methods

NSO provided the committee with various documents and statistical data about the GO programme in the past years as background information (see Appendix C). Furthermore, the committee collected additional data (see Appendix D):

1. A request for written input from the Earth observation and planetary science communities was distributed through the bi-weekly NWO electronic newsletter, the NSO webpage, and an e-mail to previous users of the GO programme. This resulted in four responses from the community.
2. A questionnaire was sent to project leaders of GO projects approved in 2012 and onwards, to request information about the present career status of (former) PhD students and postdocs hired by the GO projects.
3. In January 2021, the committee conducted an interview with two planetary scientists to discuss their written feedback on the GO programme in more detail. The committee also interviewed Dr. Radboud Koop (NSO) to get more insight in the policy aspects related to the GO programme.

Between mid-October 2020 and the end of April 2021, there were five (online) committee meetings to discuss preliminary findings and next steps.

1.5 This report

This document presents the findings and recommendations of the GO programme evaluation committee. Each aspect of the evaluation is described in a separate chapter (Chapters 2 to 4). The numbers in square brackets at the end of the subsection titles refer to the evaluation question in Appendix A (e.g. [I-A1]). In Chapter 5 the committee gives some concluding remarks. The appendices provide supplemental information.

2 – Programmatic evaluation

The evaluation committee concludes that the GO programme creates a niche that is highly relevant for both Earth observation and planetary research, for which no other funding programmes offer similar support to Dutch researchers. In light of the ever-increasing importance of the use of data generated by space infrastructure, the evaluation committee concludes that the GO targeted funding is and remains necessary (Section 2.1). The committee recommends the continuation of the GO programme with funding at, at least, the current level to i) consolidate the international position of Dutch space research in Earth observation and planetary science, and ii) stimulate further development of and spinoff to societal applications. The committee recommends a better specification of the (space data infrastructure) niche where the GO programme can make a difference, thereby taking national space and science policies into account. The committee proposes a new name for the programme that better covers its main goals: '*Scientific use of space data infrastructure support programme*' ('*Programma Wetenschappelijke Gebruikersondersteuning ruimtevaartgegevensinfrastructuur*' in Dutch) or 'WeGO' (Section 2.2).

2.1 Assessment of the relevance of the GO programme and related aspects

2.1.1 Envisaged relevance of the GO programme for Dutch science, society and economy [I-A1]

According to the committee, the GO programme creates a highly relevant and essential niche between scientifically excellent research to develop new knowledge and applications of existing and future space infrastructure, and allowing the scientific freedom to explore new innovative methodologies and approaches that can potentially be made societally relevant when the proof of concept phase is over. The committee stresses that the use of the results of scientific (Earth observation and planetary) research by the public and private sector can increase the prosperity and well-being of the nation, as well as help the Netherlands to achieve its ambition of becoming a knowledge society. In addition, Earth observation technology and applications are and will remain instrumental in the increased search for sustainable life on Earth. Insights based on Earth observation will enable organizations to take up both their economic and environmental responsibilities. For a few years now, there has been increasing interest from private companies in space exploration; this is especially true for lunar exploration. This interest will increase in the next few years and will provide further opportunities for the Dutch planetary community in the future. Also, space instruments first deployed for planetary science have later been applied for Earth observations. Over the years, the complexity of planetary exploration triggered key innovations that were very beneficial for the Earth observations in the long term[3].

The committee therefore concludes that the GO programme has great scientific and societal relevance (see Section 3.1.3 for specific examples).

Since economic criteria do not play a direct role in the project evaluations nor in the project proposals, the committee considers it impossible to make a realistic assessment of the relevance and impact of GO projects for the Dutch economy.

2.1.2 The GO programme in relation to national and international developments in space policy [I-A2]

The committee concludes that the GO programme is well aligned with one of the main goals of Dutch space policy, which is '*maximizing the societal, scientific and economic relevance of space for the Netherlands*' (4). The government states that the only way to achieve this goal is through the use of satellite data. The GO programme is also well-connected to national scientific priorities, as discussed in Section 3.2.4. Also there exists a good connection with the international developments in space policy, the most prominent example (in the field of environmental monitoring) being the contribution, also on the basis of the GO programme, to the success of the OMI- and Tropomi-instruments flying on NASA and ESA-satellites respectively.

[3] For instance, the next generation of European operational meteorological satellite (MetOp-SG) will be equipped for the first time with an instrument in the millimeter and submillimeter wave range (Ice Cloud Imager, ICI), a wave domain that has never been used before for weather forecast and that has already been observed for planetary science from space (e.g. MIRO on the Rosetta mission).

2.1.3 Overlap and/or complementarity with other - national and international – programmes [I-A3]

The committee is of the opinion that the GO programme has no real equal within Europe. The committee is aware of a few funding schemes with some resemblance within Europe, such as the STEREO programme in Belgium, while in Germany Earth observation infrastructure funding goes directly to universities. In the past, the German space agency DLR did sometimes fund user programmes for Earth observation (but not for planetary research), and also not on a structural basis.

GO funding is part of the Dutch space budget and is complementary to ESA funding. The GO programme thus enables the Netherlands to undertake research that is felt to be important but not directly done by ESA programmes. GO is as such unique. It plants the necessary scientific seeds so that sound scientific knowledge is built up for the different elements of the data chain. Those seeds can then further be picked up and flourish in research and development of the different ESA activities supported by the Dutch delegation and thus in line with the Dutch priorities.

In the GO programme, specific space infrastructures and data from them are central in the projects awarded. The committee notes that this approach allows the GO-type of research to blossom, whereas it typically falls/fell in between other disciplines where research building upon space infrastructure is not considered fundamental. The scientific themes of the Netherlands Polar Programme and NWO's interdisciplinary Planetary and Exoplanetary Science (PEPSci) programme are aligned to the GO themes, but cover much more than research based on space data infrastructure alone. Other Dutch funding programmes that are mainly complementary and not really overlapping include the Geodata for Agriculture and Water (G4AW) programme, the Small Business Innovation and Research (SBIR) Space programme, the Partnerships for Space Instruments & Applications Preparatory Programme (PIPP), and ESA's InCubed Programme in which the Netherlands participates (pay-as-you-go-programme, where NSO co-finances and makes a preselection)[4].

2.1.4 What elements of the "data chain" are only covered by the GO programme? [1-A4]

It is not unusual for satellite data to play a role in applications to NWO funding schemes. However, in many cases the proposed research does not require detailed knowledge of space instrumentation anymore. Instead, the committee considers research that involves or makes use of instrument modelling/calibration/development to be one of the core elements of the GO programme. This type of research fits the collecting – enriching part of the data chain and has been instrumental to support new ESA missions and instruments. In the opinion of the committee, another core element that so far played a not so prominent role, concerns more advanced data analyses e.g. using fusion techniques, innovative big data/cloud technologies such as deep learning to allow more enriching of available data. These advanced approaches should be application-driven and advance new data-rich applications.

2.2 Recommendations for the future

2.2.1 General recommendations

The evaluation committee stresses the importance of the GO programme for the stimulation of research using (data from) space infrastructure to develop new knowledge and applications, and recommends the programme be continued. As the focus of GO is not related to one single science discipline but aimed at encouraging the use of space data infrastructure, the committee also recommends to have a clear, well-defined specification of what kind of research it includes, and what is not included, taking into account the areas where the GO programme can make a difference. In the committee's opinion, the specification should stress the main goals to put down the foundation for new satellite missions and instrumentation, and use new levels of advanced data analyses for existing, past and future space infrastructure.

The committee also recommends considering a new name for the programme, as the current name suggests more applied research than it actually funds. The committee proposes the following new name that better covers the programme's main goals but at the same time preserves a memory of the old name: '*Scientific use of space data infrastructure support programme*' ('*Programma Wetenschappelijke Gebruikersondersteuning ruimtevaartgegevensinfrastructuur*' in Dutch) with the acronym 'WeGO'.

[4] See Appendix F for short descriptions of these programmes.

2.2.2 Improving the connection to relevant national policy strategies [I-B1]

One could create a stronger link to the national policies by taking into account the relevance of proposed GO projects for specific, predefined national policies in the evaluation of those projects. It could be a difficult and tedious task to map the national policies into a metric that can be used to benchmark project proposals. Instead the committee suggests to consider a generic metric 'Does the proposed project match with the national policies' to be scored by the evaluation committee based on the information at hand and their knowledge of the national policies. This benchmark could be added to the assessment criterion 'Scientific and/or societal impact' of the 2019 GO round. Connecting GO projects to national policies also contributes to raising the visibility of the GO results (see Section 4.2.6).

2.2.3 Continue to consolidate the position of Dutch scientists in EU context [I-B2]

a. Connection to European developments in Earth observation and planetary research

Taking into account the overall European scene with strong players in France, Germany and Italy, the Netherlands has been able to position itself quite strongly in the domain of Earth observation, by developing novel instruments and models (e.g. Dutch contributions to Sentinel 5 (Tropomi), GOME-2, FLEX, or the GHG-CCI). In planetary research, the Netherlands contributes to one of the eleven experiments of ESA's cornerstone JUICE mission to Jupiter to be launched in 2022. Various space experiments are under development and should be brought to a necessary technological readiness level to be competitive for future flight opportunities. The committee recommends that the GO programme continue to support Dutch scientists so that this position in the Earth observation domain and planetary research can be maintained and preferably expanded, based on sound scientific knowledge and experience for all elements of the data chain (collecting – enriching – utilizing). This will allow Dutch scientists to capitalize on that knowledge in research projects within the ESA or Horizon context, but also within more applied and operational programmes like Copernicus.

It is probably not realistic to have in all domains the same end-to-end cover of the data chain elements like in the atmospheric Earth observation domain. The GO programme could focus on the more downstream aspects based on available data e.g. from the Copernicus programme. The GO programme should then support the research in Earth observation data science, data analysis, and application developments in those domains that are in line with the national policy priorities.

Summarizing for Earth observation research: the Netherlands has a top position in Europe with respect to Earth observation, the GO programme should continue to lay the scientific foundation in the entire data chain (upstream i.e. collecting, and downstream i.e. enriching and utilizing) for atmospheric Earth observation. For other Earth observation domains the focus can be more on the downstream only, translating all that data into answers to the socio-economic needs. For planetary science, the committee recommends a continued alignment of Dutch efforts with ESA programming.

b. Effect on the positioning of Dutch scientists for EU-funded research projects

The committee recommends that the GO programme be continued so that – combined with the ESA programmes – the Dutch players can be in pole position to join the strategic European Space programmes. A nice example is the current and future Sentinel 5p/5 satellite that combines Dutch know-how from industry, scientists and data users, or the Dutch contribution to JUICE. The GO programme allows the planting of novel and necessary scientific seeds to grow new sound scientific knowledge, not only within academic research context but also in more applied science and engineering. Scientists themselves might evolve with the Technology Readiness Levels and move from academic science to applied science up to industrial/commercial endeavors. So apart from the scientific knowledge itself and EU-wide recognition thereof, the GO programme is an enabler for a broader ecosystem that will use the scientific results to enforce the socio-economic fabric. The presence of this broader ecosystem becomes more and more necessary as European science programmes are now evaluated (and budgeted) by impact analysis. For GO PhD students and postdocs, the GO research is an opportunity to further strengthen their record, improving their chances to be successful in other (EU-funded) programmes. Ultimately, this could lead to retaining/attracting talent in/to the Netherlands.

2.2.4 Keep the GO budget at – at least – the same level [I-B3]

The GO budgets have been in line with the ambitions and the availability of scientific resources within the Netherlands and should be kept at the same level, at least. However, the fields of Earth observation and planetary science are gaining momentum, and the potential for societal impact is growing (see Section 3.1.2). Therefore,

the committee recommends that an increased investment in research in the Earth observation domain and in planetary research is a strategic choice to be considered so that the critical (science) mass required to capitalize on these developments will become available, ready and up-to-speed.

2.2.5 The role of Data Readiness Levels within the GO programme [I-B4]

The concept of Data Readiness Levels could be used to categorize different research projects on the elements of the data chain and the expected data quality. Depending on the part of the data chain being researched, uncertainty tolerances on data will also be significantly different. For example, novel instrument techniques initially will result in data that only have exploratory value and should not be directly used in research applications. On the other hand, research in advanced data analytics could be done on datasets with the relevant data quality and operational robustness so that the uncertainty originates mainly for the algorithms used.

2.2.6 Aspects to preserve: scientific research for broad impact, capitalize on space investments [I-B5]

The GO programme establishes and enables the necessary scientific knowledge development and the exploration of applications to allow the results of this scientific research to make a broad impact (Section 2.1.1). The committee recommends fostering this and keep this ongoing at all times. The necessary scientific freedom is facilitated in the GO programme as projects are not evaluated on a hard economic return but (among other criteria) on knowledge production and utilization. Although the economic return is considered indirectly relevant, it is not a driving factor in the assessment. The committee supports this approach and recommends it should be kept this way.

A strategic choice has been made by the European Commission to engage and invest in an Earth observation programme like Copernicus. Likewise, as one of the ESA member states, the Netherlands has a stake in making missions that are of paramount importance to planetary science (e.g. ESA's JUICE mission, the James Webb Space Telescope where ESA partners with NASA) a success. The committee recommends that Dutch scientists should continue to be facilitated to capitalize on these EU/ESA investments in the newly expanded space infrastructure. The GO programme is a unique instrument to make that happen and can additionally contribute – based on sound scientific knowledge and expertise – in specific domains to the European Space infrastructure.

3 – Scientific and substantive evaluation

The committee concludes that the GO programme has enabled research projects that have led to high-quality and diverse scientific results in both Earth observation and planetary science. GO-funded projects have already demonstrated they can have broad scientific and societal impacts (Section 3.1). The committee recommends that when devising possible future GO rounds, attention be paid to inherent differences between the science areas of the programme, in terms of the amount of and access to space data and potential for societal impact, to ensure a level playing field. The committee recommends providing a clear explanation of the GO condition (see Section 1.2 for the definition). The committee also recommends considering adding exoplanetary research to the GO thematic priorities once the PEPSci programme has come to an end (Section 3.2).

3.1 Assessment of achieved results

The committee looked at several GO-related statistics (Appendix C) to put the achieved results in context. The approved and ongoing projects from the 2012 – 2016 tranche are also included for the scientific evaluation since most projects from 2017 - 2019 have not been running sufficiently long to fully judge their scientific outcomes.

3.1.1 Scientific results [II-A1]

Over the entire period 2012 – 2019, the GO programme supported a large variety of activities[5]. Their high scientific values translated in a large number of publications, in the participation of the Dutch community to several key international space missions and in the Dutch involvement in worldwide science networks.
There has been a total of ~110 publications in international refereed journals for 2012 – 2016. Some of these publications had a very significant impact on the community, with a high citation number (more than 1600 citations for one of the papers in Nature). In both Earth observation and planetary research, a large variability in the publication production is observed: from 14 publications to 0, depending on the projects. The committee checked that the publications were directly related to the activity of the PhD or postdoc hired by the programme (first authors for many publications), which is also a measure of the programme's success. Note that for the projects granted in 2016, only 4 publications were reported so far.
For the 2017 – 2019 period, the committee can appreciate the diversity of awarded projects in Earth observation, covering solid Earth, atmosphere, ocean, cryosphere, hydrosphere, and biosphere. A few papers have already been published related to the 2017 call. There are no granted planetary projects to evaluate for that period.

3.1.2 Connection to (inter)national developments in Earth observation and planetary research [II-A2]

The committee notes that currently Earth observation is making a shift from supporting technology to enabling technology. In other words, it will become more important and essential in the context of supporting sustainable life on Earth. To connect to this development, it is important to be well-positioned for international and interdisciplinary collaboration. Most GO projects include significant national and international collaborations that strongly facilitate future cooperation at larger scales. For the Earth observation community, the GO programme helps federate and consolidate the Dutch expertise at national level. It also supports the interdisciplinarity of the community and favors the competitiveness of Dutch teams at international level (ESA, EU), as illustrated in missions and projects as diverse as Sentinel 5 (Tropomi), GOME-2, FLEX, or the GHG-CCI.
Planetary research in the Netherlands currently has yet to assert itself in the European landscape and has made great progress with, among other aspects, instrument participation in the ESA JUICE mission, the establishment of the NWA Origins Center, the national membership of the NASA Solar System Exploration Research Virtual Institute, and leadership roles of Dutch scientists in the PEPSci network, the Darwin Center and the EU research infrastructure Europlanet 2020 RI and Europlanet 2024. It is the view of the evaluation committee that this

[5] Over these years, TU Delft and Utrecht University were the top contributors to the GO applications. About 44% (137 of 308) of the applications was submitted by principal investigators from one of these two universities. The remaining proposals came from 11 other universities and research institutes. The contribution of especially TU Delft increased in the 2017 – 2019 period with respect to the previous one. TU Delft submitted 18% (33/185) of all applications in 2012 – 2016, and 30% (37/123) in 2017 – 2018. Institutes for which the fraction of applications went down are Wageningen University (from 11% or 21/185 applications in the first, to 6% or 7/123 in the second period) and VU Amsterdam (16% or 29/185 applications in the first, versus 10% or 12/123 in the second period).

momentum should be maintained or built upon, especially if PEPSci funding is discontinued in the future. However, the fact that the Dutch planetary community has been particularly active over the last years is not reflected in the GO programme, with no funded projects over the last years.

3.1.3 Valorisation of the scientific knowledge [II-A3], (scientific) effectiveness of the subsidy [II-A4]

The committee notes that many GO-funded projects adopt an open source code policy and value data sharing, thus ensuring the effectiveness of the research for a larger community. The committee also recognizes that GO projects contributed to answering key societal questions and to providing advice to or input for policy makers, for instance in relation to sea level rise, flood monitoring, or aerosol production. GO projects contributed to key international reports such as Intergovernmental Panel on Climate Change (IPCC), with high impact on the public awareness for climatological and environmental issues. Knowledge from GO projects in Earth observation helped respond to practical societal questions, for instance in the field of hydrology and precision agriculture, although the committee did not note services directly derived from GO activities. The committee further points out that some instrumentation developments for planetary science could find application in the semi-conductor industry or in medicine. The willingness to contribute efficiently to end-user needs has been noted for many GO projects. The committee thus concludes that GO projects have significant potential for valorisation of the scientific knowledge gained.

The committee considers preparation for a career in the space domain also a measure of effectiveness. A questionnaire was sent to leaders of all completed GO projects from 2012 onwards to inquire after the further career of (former) GO PhD students and postdocs. Of the completed (PhD) projects (29), most PhDs and postdocs (22) remained in research or found employment at a space-related company or industry. However, a large number of PhDs have not finished yet, even for the projects funded in 2013 to 2016 (see Appendix D, Table 1).

3.2 Recommendations for the future

3.2.1 Conditions for the use of space infrastructure [II-B1]

The committee stresses that there are inherent differences between the Earth observation and planetary science communities in terms of the amount of data gathered and the way (original or primary) satellite data are made available to the research community (see point 'a' below). This can put planetary science in a weaker starting position depending on how the condition '*use of space infrastructure'* is implemented. The committee strongly recommends that attention be paid to this condition to ensure a level playing field for Earth observation and planetary science (see also Section 4.1.3 and the recommendation in Section 4.2.5).

a. Clarify the GO condition 'use of space infrastructure'

The committee recommends that the condition '*use of space infrastructure'* should be clarified by also explicitly mentioning that laboratory studies as well as ground-based and aircraft studies *necessary for the space data analysis* and the preparation of new space missions are eligible. The possibility of using data from past space infrastructures should also be emphasized. Here, improved and innovative evaluation methods (including laboratory work) can make important contributions. This is particularly important for planetary research for two reasons. Firstly, due to the more limited number of missions and space data, this supports a more effective use of data - also in preparation for future missions. Secondly, it allows for better consideration of the proprietary period during which data are not publicly available and only accessible to the instrument team, the length of which depends on the mission and instrument. This is different to most Earth observation missions where the scientific communities have immediate access to the data after validation and calibration.

b. Keep the current explanation for the term 'direct and substantial' use of space infrastructure

The committee notes that the definition of '*direct and substantial use*' can be misunderstood and requires clarification. In particular, the fact that '*substantial*' refers to the extent to which the selected data are relevant to the planned research and not to the total amount of data used, should be clear. The committee recommends that in the future '*direct and substantial use*' be explained as in the 2019 GO Call, which provided a good explanation.

c. Maintain and clarify the research option 'preparation for new missions'

The committee considers the research option 'preparation for new missions' as an important component to advance the method development and calibration/validation efforts in parallel with instrument development. The committee recommends maintaining this option, and notes that it should be mentioned explicitly that it can include preparatory measures in the area of laboratory work, ground-based observations, and aircraft studies that pertain to the use of space data infrastructure

3.2.2 Valorisation [II-B2]

a. Appreciate difference in the potential for societal and economic relevance

The committee recognizes that GO projects can have significant valorization potential (Section 3.1.3). In general, however, the committee notes that the societal relevance or knowledge utilization criterion can be problematic for planetary research and for some areas in Earth observation where societal impact takes place on the long term or is less concrete (see also the recommendation in Section 4.2.7).

b. Outreach and teaching as a 'downstream activity'

While the direct social and economic relevance of planetary science projects is generally lower than for Earth observation, society's interest in planetary science, especially the topics of extraterrestrial life and habitability, is very high and perceived positively. This could be strengthened with outreach activities and teaching in schools.

c. Connection to other NWO programmes

The GO programme can strengthen the link between atmospheric and exoplanet research and complement activities at the NWA Origins center (see next point).

3.2.3 Research categories covered by the GO programme [II-B3]

The committee recommends that Earth observation and planetary science be kept as thematic priorities in the GO programme, and also appreciates the new development in exoplanetary research. This new community uses space and ground-based infrastructure to determine the atmospheric composition including biomarkers, structure and dynamics of exoplanets. Coming ESA missions such as Ariel and PLATO will provide new space data in addition to existing space missions and ground-based infrastructure. As a result, a close link between atmospheric and exoplanet research has been developing for some time. Currently, the PEPSci network stimulates collaboration between Dutch Earth, planetary and exoplanetary scientists. Once PEPSci has come to an end, the committee recommends considering adding exoplanetary research to the GO themes, to complement activities at the NWA Origins center.

3.2.4 Connection to relevant national scientific priorities [II-B4]

The GO programme clearly ties in with the priorities of the Dutch Earth and planetary scientists. The committee recommends that a connection be sought to the specific area(s) where the GO programme can make a difference, as described in the following two papers.

The Dutch national ambitions in terms of space policy have led to the 'Earth observation research in the Netherlands Strategic Plan 2020 – 2025', resulting from the research community, which includes the following main recommendation to policymakers: '*to improve the balance between investments made in new satellite missions/instrumentation, in ground-based infrastructure (e.g. for calibration and validation of satellite data) and in data exploitation (data use)'* (5). According to the committee, this point is relevant for the GO programme as it clearly identifies the specific niche where GO can make a difference. Furthermore, the strategic plan pushes the scientific community '*to utilize the full potential of available satellites, achieve an adequate modelling capacity, and exploit the resulting data to address scientific and societal challenges*'. This was stimulated by facilitating '*interdisciplinary* [Earth observation] *research and inter-community collaboration*' and encouraging '*the contribution of* [Earth observation] *data to SDG's*, *NWA and Topsectors/KIA's*' (5). Also here, the committee sees a clear role for GO.

In 2019, the community of Dutch planetary scientists presented the 'Planetary Sciences & Exploration Position Paper for the NSO Strategic Plan Space Policy'. This document describes the space-based aspects of developments, activities and plans/expectations for the future in the fields of planetary sciences and exploration with a focus on instrumentation and infrastructure. The evaluation committee highlights that the position paper describes the GO programme as '*invaluable […] for the NL community to utilize data*' and '*essential for calibration and validation purposes and using space-borne data at levels 1 and 2 for (inter)planetary missions*'.

3.2.5 Facilitating calibration/validation, interdisciplinary and data-science research activities [II-B5]

The committee recommends that no changes be made to the GO programme in its 2019 form to better facilitate calibration/validation activities, and interdisciplinary or data-science components. The last call already included for the science criterion '*the extent to which the research contributes to a better utilization of the space infrastructure (for example through calibration/validation, data exploitation and/or algorithm development)*' and inherently targets an interdisciplinary community. Also, the committee does not see a need to reissue a specific call promoting data science (as in 2018), as it can be naturally included in many projects as a powerful tool for the exploitation of satellite observations.

4 – Evaluation of implementation aspects

The evaluation committee also assessed the implementation procedure of the GO programme. Section 4.1 presents the findings of the committee regarding matters such as the efficiency of the procedure, the tasks of reviewers and assessment committee, the applicability of the standard NWO criteria and subsidy conditions, and the visibility of the results of the subsidized proposals. The general conclusion is that the evaluation committee is satisfied by the way the GO programme is implemented and executed in practice. Nevertheless, Section 4.2 gives some recommendations for the future - based on the findings of Section 4.1, e.g. about the guarantee that both GO scientific themes are supported in each round and about the efficiency of the application procedure.

4.1 Assessment of the implementation procedure

4.1.1 Efficiency of the procedure [III-A1]

It is the opinion of the committee that overall, the GO programme implementation is a carefully designed procedure. Our analysis showed that this procedure is correctly followed and carried out by all those involved. The committee has only two remarks.

Firstly, the quality control process whether the actual research activities match with the original proposal is a weak link in the procedure. Whereas during the application phase reviewers and an assessment committee are active, during and at the end of the research phase only the coordinator of the GO programme is checking (rather generally) the progress and conformity of the research with respect to the original proposal. The committee acknowledges that according to the current procedure, project leaders already have to ask formal permission from NSO to make substantial content-related and certain budgetary changes. The committee also recognizes that research projects are often unpredictable, and that plans or strategies can change based on new findings or unexpected circumstances. However, the committee stresses the need for requesting (and receiving) mid-term and final reports by the lead researcher in a timely fashion, to be able to evaluate, check or discuss any anticipated changes properly and to ensure that researchers take this condition seriously.

Secondly, the committee notices that the total process of writing proposals and assessing them by reviewers and the assessment committee, is a (relatively) time-consuming procedure for all people involved.

4.1.2 Choice of reviewers [III-A2]

The input from the community gathered by the committee did not include any complaints about the way the reviewers for the initial assessment of the proposals are chosen or perform their task. In addition, it is also the committee's own opinion that the process works well and does not require any changes.

4.1.3 Composition and role of assessment committee [III-A3]

In the opinion of the evaluation committee, the composition of the assessment committee has shown a balanced representation of all relevant scientific fields of attention. The evaluation committee stresses the importance of safeguarding this balanced representation in the future. The remark of the previous evaluation committee is still a point of attention: many researchers who are qualified to take part in the assessment committee are usually also proposers, and therefore the choice of potential members is often quite limited. However, no evidence has been found that this has been a problematic issue in recent years.

The evaluation committee received some comments from the community with respect to the representation from the side of planetary research in the assessment committee. These comments are connected to the zero success rates of planetary proposals between 2017 and 2019. Without any direct insight in the discussions of the assessment committee, the evaluation committee cannot completely rule out that an (implicit) bias against planetary science has played a role.

The fact that in the period 2017 – 2019 not a single planetary science proposal received GO funding, is a break from the trend between 2012 and 2016. Therefore, the evaluation committee paid special attention to the changes in the implementation procedure as summarized in Section 1.2. The most notable one is that in 2017 and 2018, the GO criterion was implemented as a criterion to be scored by the assessment committee, whereas in 2012 – 2016 and in 2019 it was an eligibility criterion assessed by NSO. A statistical test was performed (using a bootstrap approach) for the GO rounds of 2012 to 2019 to get insight into whether the planetary proposals *as a group* were scored very differently by the assessment committee than the Earth observation proposals, or whether the fact that no planetary proposals were funded could be explained by their small numbers (see

Appendix D for details). The conclusion is that – statistically speaking – there are no clear-cut differences in how proposals from each theme performed in 2012 – 2016 and 2019: overall, the ratio between the number of successful Earth observation and planetary science proposals was as could be expected. The years 2017 and 2018 stand in contrast: the planetary science proposals performed significantly worse on the GO criterion — not unexpected as described in Section 3.2. More surprisingly, the planetary science proposals *as a group* also performed worse on criteria on which they performed similarly to the Earth observation proposals in other years[6]. The only explanation for such an effect that the committee could think of is that in 2017 and 2018 the GO criterion was an assessment criterion and not an eligibility criterion, possibly unintentionally affecting the assessment committee's judgement on non-GO criteria as well (an implicit bias effect). As this was – justly, according the evaluation committee – corrected for in the 2019 Call, the committee is of the opinion that the present implementation of the GO criterion creates a level playing field for both themes, keeping in mind that (given their small numbers) it could still happen that no planetary proposals receive funding.
To conclude, the role of the assessment committee in the procedure is clear. The evaluation committee is convinced that the members of the subsequent assessment committees carefully and with integrity fulfilled their responsibilities.

4.1.4 Standard NWO criteria and subsidy conditions [III-A4]

The committee has received no complaints about the way the standard NWO criteria and subsidy conditions are applied. It is also the committee's own opinion that this part of the process works well.

4.1.5 Visibility of the results [III-A5]

The committee emphasizes that in the GO programme the term '*visibility of the results'* is not explicitly defined. The committee is of the opinion that the visibility aspect should be stressed more to create awareness of the value of GO research. The focus of the GO programme is fundamental (translational) research and not so much applied research. However, it would be good not to lose sight on the matter of '*scientifically relevant'* versus '*societally relevant'*. Valorization of scientific knowledge resulting from GO-funded research can be and has been an important by-catch of the GO programme (see examples in Section 3.1.3). One can of course count the number of citations of scientific papers resulting from the funded research. But also attention for the project in the media is a form of visibility, or the possible use of results by government agencies or commercial firms. For the committee it is clear that a higher visibility profile is possible when a proposal fits in policy areas such as the NWA routes, the Top Sectors or the National Safety and Security Strategy (see also Section 2.2.2).

4.2 Recommendations for the future

4.2.1 Monitor to what extent the actual research activities follows the original proposal

To guarantee better that the actual research does not deviate too easily from the original research proposal, the present system of mid-term progress report and final report by the lead researcher should be strictly enforced and should – if necessary – lead to a discussion with NSO/NWO about the results.

4.2.2 Make the application procedure more efficient

For improved efficiency in the work of the reviewers, of the assessment committee and of the scientists who write the proposals, the committee recommends to consider splitting up the application procedure in two phases, as is sometimes done in other NWO funding programmes. In the first phase, applicants are asked to submit a brief outline of the proposal to be assessed by the evaluation committee (possibly not on the entire set of assessment criteria). In the second phase, only about the top half of the proposals are invited to submit a full proposal that is assessed according to the current procedure. The advice to write a full proposal could be binding or non-binding: the committee leaves this choice to NWO and NSO. The disadvantage of this recommendation is

[6] For example, on the criterion '*Scientific quality of the team'* the planetary proposals scored poorly in 2017 while in the previous years, planetary proposals scored comparably to Earth observation proposals on this criterion. Another example: on the knowledge utilization criterion, introduced in 2017, the planetary proposals performed poorly in 2017 and 2018, but comparably to the Earth observation proposals in 2019.

that the total procedure may take somewhat longer. On the other hand, it will lower the total time commitment by all involved.

4.2.3 Enhance even more the quality of the work of the assessment committee

To check whether the work of the assessment committee is not disturbed by a possible implicit bias introduced by the assessment criteria, one could repeat a statistical test similar to the one described in Appendix D (for example, every other year) to check for unwanted systematics in the scoring and react accordingly.

4.2.4 Guarantee that both GO scientific themes are supported in each round

The committee recommends to support both thematic priorities of the GO programme in each GO round. To guarantee the continuous support of planetary science – knowing that the number of planetary proposals is much smaller than the number of Earth observation proposals – the committee recommends that the highest ranking proposal of each of the two GO scientific themes (Earth observation and planetary science) is funded anyway, provided the proposal is of sufficient quality (as defined in the Call for Proposals). The other successful proposals should then – in the normal way – be selected for funding following the ranking based on the assessment committee's evaluation.

4.2.5 Continue using the '*extent of use of space infrastructure*' as an eligibility criterion

In order to ensure a level playing field for both Earth observation and planetary science proposals, the committee recommends that the criterion on the use of space infrastructure not be used as an assessment criterion, but should remain an eligibility criterion.

4.2.6 Enhance the visibility of the results

The visibility of the results can be improved by asking to indicate in the proposal whether it fits in national policy areas such as the NWA routes, in the present Top Sectors or mitigates risks mentioned in the National Safety and Security Strategy. If this is the case, automatically the visibility of the research results will be higher. Other aspects to be addressed in the proposal could be what kind of attention in the media is expected for the proposed research during the course of the research work, or what the foreseeable use of results is by government agencies or commercial firms.

4.2.7 Better instruction regarding knowledge utilization

The committee recommends that a better instruction for the societal impact or knowledge utilization criterion towards the referees and assessment committee be given (to create awareness that e.g. public outreach initiatives are considered knowledge utilization as well in the definition adopted by NWO), and that a weight of 12.5% (not less) for the knowledge utilization criterion (as adopted in the Calls of 2017 and 2018) is appropriate given the programme's emphasis on scientific research. The committee cautions against evaluating the societal benefit of a project only on the short-term return as it could jeopardize the planetary science and Earth observation activities with long-term societal effects.

5 – Concluding remarks

The overall and unanimous conclusion of the committee is that the GO programme has clearly fulfilled its unique niche and generated the desired impact, and therefore strongly recommends the GO programme be continued. The funded research projects have led to high-quality and diverse scientific results in both Earth observation and planetary science. Both disciplinary fields should therefore be continued to be supported by the programme. Considering that the use of data generated by space infrastructure is becoming more and more relevant in a scientific and societal context, the committee also concludes that the GO-targeted funding is and remains necessary at - at least - the same level. We do suggest to better specify the future calls and change the name of the programme to emphasize its specific goal.
As for the programmatic aspects, the committee finds that the GO programme is well aligned with one of the main goals of Dutch space policy, viz. '*maximizing the societal, scientific and economic relevance of space for the Netherlands*'. Since the focus of the GO programme is not related to a single discipline but aimed at encouraging the use of space data infrastructure, the committee considers it very important to have a clear specification in future calls what type of research the programme covers, and what it does not cover.

As for the implementation aspects, the committee recommends more systematic monitoring of the project execution and its outcomes to allow better impact assessment. The committee evaluated possible reasons for unbalanced funding outcomes during several earlier calls. Fortunately, the lessons from these past calls have already led to a more balanced approach in evaluating and awarding projects from 2019 onwards. Therefore, the committee is satisfied by the way the GO programme is implemented and executed in practice.

6 – References

1. NWO, 2019, *GO Call for Proposals 2019*

2. Netherlands Space Office, 2019, *NSO-advies voor het ruimtevaartbeleid vanaf 2020*

3. *NWO has been hacked. What does this mean in practice?*, 2021

4. *Space policy memorandum 2019 (Nota Ruimtevaartbeleid 2019)*, 2019

5. S. Houweling, E. van Sebille, C. van der Tol, W. van der Wal, B. Wouters (eds), 2019, *Earth Observation Research in the Netherlands - Strategic Plan 2020 - 2025*

6. *NWO Code for Dealing with Personal Interests*

7. *NWO research fields*

8. *NWO Money Follows Collaboration*

9. Dialogic, 2021, *Beschrijving en evaluatie ruimteonderzoek in Nederland*

10. —, 2020, *Brede verkenning toegevoegde waarde ruimtevaart voor Nederland*

11. —, 2021, *Evaluatie Kennisnetwerkenregeling en Instrumentenontwikkelingsprogramma*

Appendix A – Main questions of the evaluation

The assignment given to the evaluation committee was laid down in the Terms of Reference, which were formally approved by the NWO Domain Science Board in July 2020. The evaluation assignment consists of three components, each with an assessment and recommendation part.

I. Programmatic evaluation

I-A. Assessment of the relevance of the GO programme and related aspects

Based on the programme's objectives, the committee was asked to assess the activities that have been carried out, as well as the following aspects of the GO programme:

1. envisaged relevance of the GO programme for the Dutch scientific sector, society and economy;
2. national and international developments in space policy and how the GO programme has responded in terms of e.g. connection, position, synergy, and complementarity;
3. overlap and/or complementarity with other - national and international - programmes, such as other NWO programmes, space programmes, ESA and EU programmes, etc.; what specific gaps the GO programme fills and what gaps still remain;
4. what elements of the 'data chain' (collecting data - enriching data (linking, combining) - utilising data) are only covered by the GO programme and what elements are also covered by other programmes.

I-B. Recommendations for the future

The future development of the GO programme is an important factor in the evaluation committee's assignment. The committee was asked to offer programmatic recommendations based on the findings from component I-A and aided by the following questions:

1. Are there any points on which the GO programme's connection to relevant national policy strategies (as detailed in e.g. the National Earth Observation Research Strategy 2020 – 2025, the Planetary position paper, the Space Policy Memorandum 2019 and the mission-driven Top Sectors and Innovation policy) can be improved and if so, how?
2. European programmes:
   a. Can any aspects of the GO programme's connection to European developments in Earth observation and planetary research (e.g. in the context of the ESA Science and Earth Observation programmes, the EU Copernicus and Horizon programmes and the joint ESA-EU "Grand Science Challenges" related to Earth system science) be improved and if so, how?
   b. To what extent does the GO programme contribute to an improved positioning of Dutch scientists for EU-funded research projects?
3. (Why) is the budget for the GO programme sufficient or will more or less support be needed in the future?
4. Can the concept of Data Readiness Levels (DRLs) play a role within the GO programme? If so, how?
5. What aspects of the GO programme, regarding its relevance and its position within the full (policy) toolbox, are seen as positive and should be preserved?

II. Scientific and substantive (content-related) evaluation

II-A. Assessment of achieved results

Based on the programme's objectives, the committee was asked to assess the activities that have been carried out and the scientific results that have been achieved, taking into account at least the following aspects:

1. scientific results as defined in the Strategy Evaluation Protocol (SEP), Appendix E;
2. national and international developments in Earth observation and planetary research and how the GO programme responded to these developments;
3. valorisation of the scientific knowledge;
4. (scientific) effectiveness of the subsidy.

II-B. Recommendations for the future

The future development of the GO programme is an important factor in the evaluation committee's task. The developments and considerations outlined in Appendix 1 of the Terms of Reference play a role therein. The committee was asked to make scientific and content-related recommendations based on the findings from component II-A and aided by the following questions:

1. Conditions for the use of space infrastructure:
    a. Should the GO condition '*use of space infrastructure'* be clarified and/or modified? If so, why and how?
    b. Should the definition of '*direct and substantial'* use of space infrastructure be clarified and/or modified? If so, why and how?
    c. Should the research option 'preparation for new missions' be maintained and/or modified? If so, why and how?
2. Valorisation:
    a. What is the societal and economic relevance of the scientific results? To what extent is knowledge from GO projects used for the development of services/applications?
    b. How could a connection to downstream activities be incorporated into the GO programme, if desired?
    c. To what extent could/should research within the GO programme be better connected to other NWO programmes, e.g. the NWA?
3. What research categories should a new GO programme include (Earth observation, planetary research, other)?
4. To what extent does the GO programme tie in with relevant national scientific priorities, e.g. those specified in the National Earth Observation Research Strategy 2020 – 2025 and the Planetary position paper? Are there points on which this connection could be improved and if so, how?
5. Should the GO programme be modified in order to better facilitate i) research proposals with calibration/validation (cal/val) activities as their primary focus, ii) interdisciplinary research proposals and/or iii) research proposals with a data science component? If so, why and how?

III. Evaluation of implementation aspects

III-A. Assessment of the implementation procedure

The evaluation committee was also asked to assess the implementation procedure followed so far, taking into account at least the following aspects:

1. efficiency of the procedure;
2. choice of reviewers;
3. composition and role of the assessment committee;
4. standard NWO criteria and subsidy conditions;
5. visibility of the results.

III-B. Recommendations for the future

The future development of the GO programme is an important factor in the evaluation committee's task. The developments and considerations outlined in Appendix 1 of the Terms of Reference play a role therein. The committee was asked to make implementation-oriented recommendations based on the findings from component III-A and aided by the following questions:

1. What are the pros and cons of assessing the research categories 'Earth observation research' and 'planetary research' separately? If desired, how should such an arrangement be implemented?
2. In the event of a new GO programme, can the efficiency of the implementation procedure be improved somehow? If so, what modifications might contribute to this improvement?
3. How can the visibility of the contributions made by GO research to Dutch society be improved?

Appendix B – Description of GO programme

The following outline of the GO programme reflects the description in the Call for Proposals 2017, 2018 and 2019.

Aim

The Netherlands contributes to the construction and maintenance of advanced and diverse infrastructure in space. Encouraging the use of this infrastructure for the benefit of science and society is one of the priorities of Dutch space policy. The GO programme is one of several funding schemes that are part this policy. The aim of the GO Programme is *'to provide support to researchers working in the Netherlands with the (preparation for) use of infrastructure in space for the purpose of high-quality scientific research'* (1) within the research focus areas as specified below.

Use of space infrastructure

In line with the programme's goal to encourage the use of space infrastructure, the GO programme is only open for scientific research that will make direct and substantial use of the space infrastructure and the primary data/signals it produces (this is also referred to as the 'GO condition'). '*Substantial use'* refers to the extent to which the selected data are relevant to the planned research, rather than to the total amount of data used. '*Direct use'* refers to the use of original or 'primary' data: data which have not yet been irreversibly influenced or changed, i.e. raw data or (geo)physical variables directly derived from raw data. The use of so-called 'secondary' data, such as further derived and/or combined data (i.e. data not exclusively originating from space infrastructure), literature values, or datasets consisting of simulated results, is seen as '*indirect use*'. This space infrastructure includes scientific and operational satellites and space vehicles that are managed by (inter)national space agencies such as ESA, NASA, JAXA, CNES, ISRO, CNSA and DLR, international institutional organisations such as the EU and EUMETSAT, and/or commercial providers. The space infrastructure stated is understood to include (a) (currently or in the past) existing space infrastructure, and (b) planned space infrastructure, which is being developed within a programmatic framework or is at least being considered in a peer-review process. Starting in 2017, the GO condition was more strictly enforced.

Thematic priorities

The GO programme is only open for scientific research in the areas of (1) Earth observation (including the areas geosphere, hydrosphere, atmosphere, cryosphere, biosphere and anthroposphere, as well as research where these areas intersect) and (2) solar-system planetary research (planetary evolution and habitability). Both themes are scientific priorities in the current Dutch space policy. The programme is also open to research that combines both areas.

Budget

The total budget for the GO programme in the period 2017 – 2019 amounted to M€ 7.2 (excluding implementation costs). Three annual calls were issued, each with a budget of M€ 2.4. The previous period (2012 – 2016) had an annual budget of M€ 1.9.

What can be applied for

Applicants to the GO programme can request funding for one PhD student or postdoctoral researcher and material costs (in 2017 and 2018: max. k€ 50; in 2019: max k€ 15 per year per full-time equivalent scientific position) directly related to expenses that are necessary for the realisation of the research described in the application. The requested funding may not exceed the maximum of k€ 300 (2019). In 2019, applicants could opt to apply for funding (not to exceed 50% of the total requested budget) to realise part of the project at a publicly funded knowledge institution outside the Netherlands[7].

The GO Call 2018: eScience component

An additional aim of the GO Call 2018 was to further enhance the potential impact of space research projects, by combining and integrating the proposed research with the advanced capabilities of state-of-the-art eScience technologies. To achieve this, a data science component was added to this Call in collaboration with the Netherlands eScience Center (NLeSC) by way of a one-time pilot. Besides inviting regular applications, the Call

[7] This is NWO's '*Money follows Cooperation'* budget module (8), it is not specific to the GO programme.

also welcomed applications with an eScience component. Applications in the latter category could ask for an in-kind contribution in the form of NLeSC eScience research engineers. Different assessment criteria and different weights (see Table 1) applied to these eScience applications. Afterwards, this pilot was evaluated with the help of a survey open to all GO researchers. The main outcome was the recognition of the added value of data science technologies for (certain types of) Earth observation research. However, doubts were raised with regard to e.g. the programmatic structure of the call and its limited usefulness for planetary researchers.

Assessment criteria

Each member of the assessment committee scores the applications on several assessment criteria that contribute with varying weights to a combined score (see Table 1).

Call 2017	Call 2018	Call 2019
1. Originality/Innovative character (25%)	1. Originality/Innovative character (25%; *17.5%*)	1. Scientific quality of the proposal (40%)
2. Scientific quality of the proposal (25%)	2. Scientific quality (37.5%; *26.25%*)	2. Scientific and/or societal impact, including knowledge utilization (40%)
3. Scientific quality of the group (12.5%)	3. Extent of use of the space infrastructure[8] (25%; *17.5%*)	3. Quality of the research team (20%)
4. Extent of use of the space infrastructure[8] (25%)	4. Knowledge utilization (12.5%; *8.75%*)	
5. Knowledge utilization (12.5%)	*5. eScience state-of-the-art[9] (15%)*	(Use of space infrastructure is part of the eligibility check)
	6. *Lateral impact, re-use and sustainability[9] (15%)*	

Table 1 – Assessment criteria of the GO Calls in the years 2017, 2018 and 2019. The additional criteria and modified weights for the eScience applications in the 2018 Call are indicated in blue.

Assessment procedure

The GO assessment procedure is based on the standard NWO procedure. The assessment of GO applications is performed by the GO assessment committee. The committee is appointed by the NWO Domain Science Board and is headed by an independent chair who supervises the entire process. The GO assessment committee is appointed annually after receipt of the applications. NSO uses a list of candidate committee members approved by the NWO Domain Science Board. In order to guarantee objectivity and transparency in the process of assessment and decision-making, the NWO Code for Dealing with Personal Interests (6) is taken into account.
The assessment committee will issue an advice to the NWO Domain Science Board regarding the assessment and priority ranking of the project proposals.
In summary, the assessment procedure consists of the following steps:

1. selection of international expert referees by NSO and/or the assessment committee;
2. advice from the international referees of the individual project proposals (at least 2 per proposal);
3. rebuttal procedure regarding the anonymized advice from referees;
4. individual assessment and ranking by the members of the assessment committee (in writing) of the project proposals (including referee comments and rebuttals). The total score of all committee members will result in a preliminary ranking;
5. meeting of the assessment committee during which all proposals are discussed and the committee members have the opportunity to adjust their pre-scores. Based on the adjusted scores a new ranking is made. The meeting results in 1) an assessment advice for each proposal and the priority ranking, and 2) advice to NWO Domain Science Board;
6. decision about the allocation of funding by the NWO Domain Science Board, based on the recommendations of the assessment committee.

[8] A score of «very good» or «excellent» for this criterion is required to qualify for funding.
[9] Assessment criteria 5 and 6 only apply to proposals with an eScience component

Appendix C – Information provided to the evaluation committee

At the start of their activities, the evaluation committee was provided with several documents (Section C.1) and statistical data about the GO programme in the past years (a selection of which is given in Section C.2) to serve as background information.

C.1 Literature

- Terms of Reference of the GO evaluation 2020, including a description and motivation for the assessment
- Space Policy Memorandum (Nota Ruimtevaartbeleid) 2019
- Earth observation research in the Netherlands, Strategic Plan 2020 - 2025
- Strategic input from Dutch planetary scientists for the NSO Space Policy Memorandum: Planetary Sciences & Exploration Position Paper 2019
- Evaluation report National User Support Programme Space Research (GO) 2012 – 2016
- GO call for proposals 2017
- GO call for proposals 2018
- GO call for proposals 2019
- Strategy Evaluation Protocol (SEP) 2021-2027
- Results of a questionnaire about the inclusion of a data science component in the GO Call 2018
- List of publications resulting from GO projects 2012 – 2019

In addition, the committee was provided with details regarding the assessment procedure, and with summaries of the GO applications submitted in the years 2017 – 2019.

C.2 Selection of statistical information for the GO rounds 2012-2019

C.2.1 Applications per theme

Because of the broad thematic range of Earth observation research, during the period 2012 – 2016 (second tranche) this was subdivided into a number of themes. The choice of theme for each proposal is based on the option selected by the applicants themselves. From 2017 – 2019 (third tranche) this subdivision was no longer maintained, i.e. there were only two themes: Earth observation and Planetary research.
In order to make something of a comparison possible between the two tranches, themes have also been selected for the 2017 – 2019 (third tranche) proposals, however please note that this was done by NSO staff rather than by the applicants themselves. Table 2 compares the number of applications per theme over the years. This information has only been included in order to facilitate a historical perspective.

	GO Programme 2012-2016					**GO Programme 2017-2019**		
Themes	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Atmospheric research	15	7	11	13	6	5	11	8
Solid Earth	1	1	3	3	3	6	4	6
Water	10	8	4	3	4	11	10	9
Land processes	7	5	7	6	2	5	10	16
Combination of themes	4	2	3	7	9	1	2	2
Planetary research	7	10	6	12	6	5	5	4
Total number of applications:	***44***	***33***	***34***	***44***	***30***	***33***	***42***	***45***

Table 2 – Number of applications per theme per year.

C.2.2 Applications and awards per discipline

NWO works with 'discipline codes' (7) for different areas of research. The applicant is required to indicate the main disciplines of their proposal (max. 4) when submitting their application. Table 3 shows the first discipline selected for each proposal, as the assumption was made that this would be most representative of the proposal as a whole.

		GO Programma 2017 – 2019					
		2017	2017	2018	2018	2019	2019
Research field	**Code**	**Applications**	**Grants**	**Applications**	**Grants**	**Applications**	**Grants**
Geotechnics	14.60.00						
Geochemistry, geophysics	15.10.00	1	0	1	0	2	0
Geodynamics, sedimentation, tectonics, geomorphology	15.30.00	3	3	3	0	3	1
Petrology, mineralogy, sedimentology	15.40.00						
Atmosphere sciences	15.50.00	5	2	10	4	8	1
Hydrosphere sciences	15.60.00	10	2	6	3	7	2
Geodesy, physical geography	15.70.00	3	3	7	2	5	2
Earth sciences, other	15.90.00	2	1	6	0	7	2
Artificial intelligence, expert systems	16.60.00					1	0
Ecology	22.40.00			1	0	2	1
Geography	49.10.00	1	0	2	0	3	0
Environmental science	50.90.00	3	0	1	0	3	0
Planetary science	17.10.00	5	0	5	0	4	0
Total		**33**	**11**	**42**	**9**	**45**	**9**

Table 3 – Number of applications per research area as defined by the NWO discipline code per year.

C.2.3 Applications and awards per institute

Table 4 shows the number of applications, granted projects and funding rates per institute per year for the periods 2012 – 2016 and 2017 – 2019.

	2012			2013			2014			2015			2016			2017			2018			2019		
Institute	**A**	**G**	**F**	**A**	**G**	**F**	**A**	**G**	**F**	**A**	**G**	**F**	**A**	**G**	**F**	**A**	**G**	**F**	**A**	**G**	**F**	**A**	**G**	**F**
TU Delft	5	2	40%	4	2	50%	7	2	29%	12	4	33%	5	1	20%	9	3	33%	11	2	18%	17	4	24%
Twente University	7	0	0%	5	1	20%	5	1	20%	4	0	0%	2	0	0%	4	2	50%	5	0	0%	6	1	17%
Utrecht University	12	3	25%	8	2	25%	5	2	40%	5	1	20%	9	2	22%	6	2	33%	10	3	30%	10	2	20%
VU Amsterdam	6	2	33%	5	1	20%	7	2	29%	7	2	29%	4	3	75%	4	0	0%	5	1	20%	2	0	0%
Wageningen UR	3	1	33%	5	0	0%	4	0	0%	5	0	0%	4	2	50%	3	0	0%	4	1	25%	-	-	-
University of Amsterdam	-	-	-	1	0	0%	1	0	0%	2	1	50%	-	-	-	-	-	-	-	-	-	-	-	-
Leiden University	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0%	3	0	0%
University of Groningen	-	-	-	-	-	-	-	-	-	1	1	100%	-	-	-	-	-	-	1	0	0%	1	0	0%
TU Eindhoven	1	0	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Open University	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	0%
KNMI	9	1	11%	1	0	0%	1	0	0%	4	0	0%	2	1	50%	1	0	0%	3	2	67%	2	0	0%
NIOO-KNAW/NIOZ	-	-	-	2	1	50%	1	1	100%	-	-	-	2	2	100%	4	2	50%	2	0	0%	2	1	50%
SRON	1	0	0%	2	1	50%	3	0	0%	4	2	50%	2	1	50%	2	2	100%	-	-	-	1	1	100%
Total	**44**	**9**	**20%**	**33**	**8**	**24%**	**34**	**8**	**24%**	**44**	**11**	**25%**	**30**	**12**	**40%**	**33**	**11**	**33%**	**42**	**9**	**21%**	**45**	**9**	**20%**

Table 4 – Number of applications (A), number of granted projects (G) and funding rates (F = G/A) per institute per year.

C.2.4 Total granted budget

Table 5 provides the total budget that was granted per year for the period 2012 – 2016 and 2017 – 2019.

Round	Number of granted projects	Total budget granted
2012	9	*€ 2.037.196*
2013	8	*€ 1.816.438*
2014	8	*€ 1.886.830*
2015	11	*€ 2.714.251*
2016	12	*€ 2.796.210*
2017	11	*€ 2.623.021*
2018	9	*€ 2.330.644*
2019	9	*€ 2.635.676*

Table 5 – Number of granted projects and total budget granted per year.

C.2.5 Applications and awards by gender

Figure 1 shows the number of applications and granted projects by gender (male/female) of the main applicant per year for the period 2012 – 2016 and 2017 – 2019. Figure 2 shows the funding rate by gender for the same period.

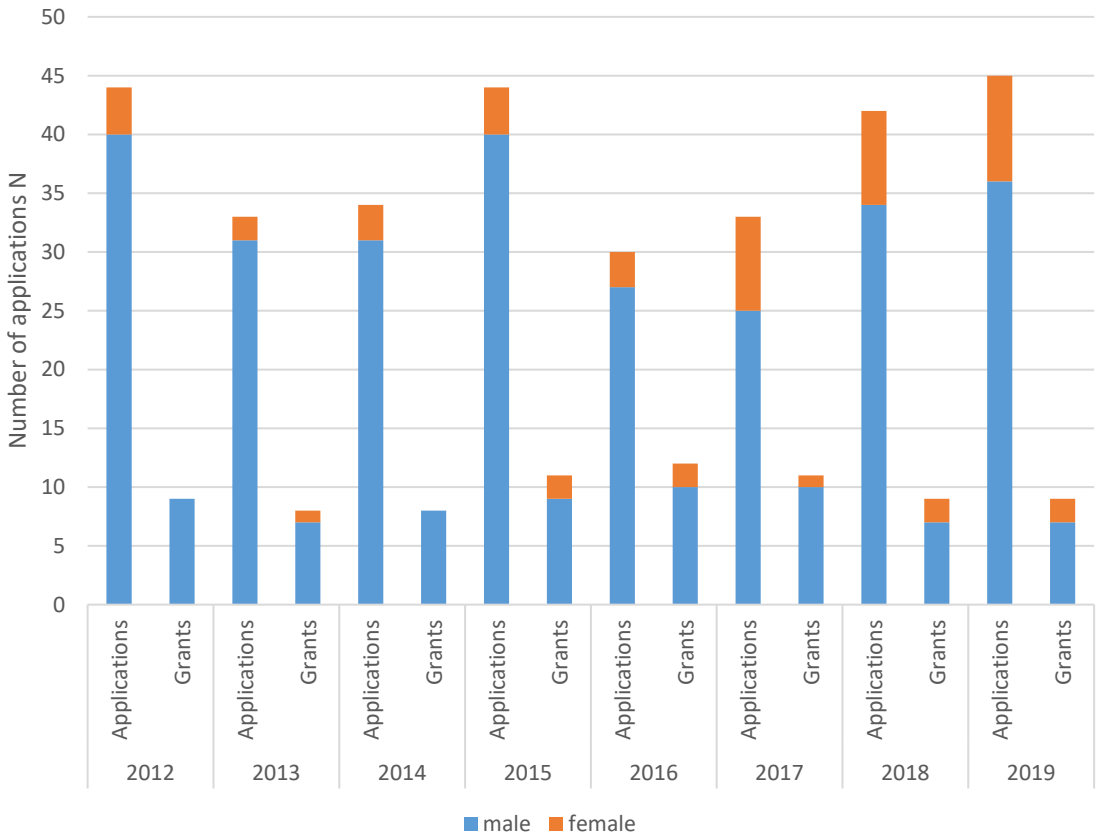

Figure 1 – Number of applications and number of grants for male and female main applicants, per year.

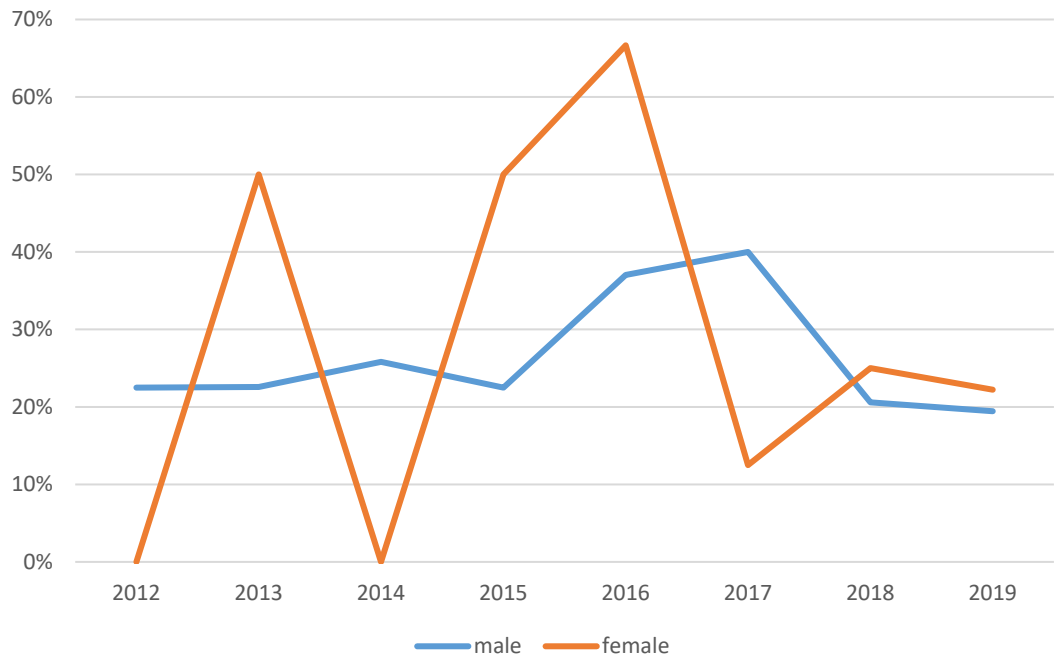

Figure 2 – Funding rate (number of granted projects / number of applications) for male and female main applicants per year.

C.2.6 Personnel funded by GO projects

Within the GO calls, projects can apply for either a PhD student or a postdoc; per project, only one position can be funded. Figure 3 shows whether granted projects were carried out by a PhD student or a postdoc.

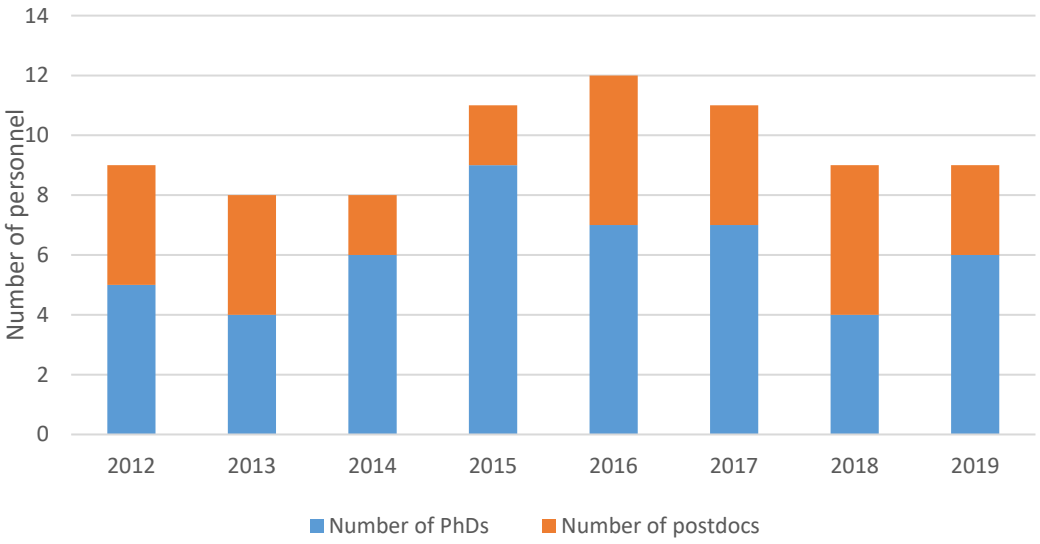

Figure 3 – Number of projects that hired a PhD student and number of projects that hired a postdoc, per year.

C.2.7 Publications related to GO projects

Table 6 shows the number of the different types of publications (peer-reviewed articles, PhD theses and other) related to projects funded by the GO programme during the periods 2012 – 2016 and 2017 – 2019. 'Other' can refer to conference proceedings, publications in popular magazines, etc.

Year of publication	Peer-reviewed articles	PhD theses	Other
2012	1		
2013	5		3
2014	4		2
2015	18		3
2016	17		1
2017	22	2	
2018	23	4	
2019	18	1	
2020	3		1

Table 6 – Number of peer-reviewed articles, PhD theses and other publications related to GO projects per year. The reference date for the table is October 28, 2020.

C.2.8 Funding rate for Earth observation and planetary science

The grey line in Figure 4 show the total funding rate for all proposals (i.e. regardless of topic) for each year in the period 2012 – 2019, where the funding rate is the total number of granted proposals / total number of applications. Funding rates are also shown for Earth observation (blue) and planetary science (orange) separately. Table 7 shows the number of granted proposals for each year in the period 2012 – 2019, as well as the funding rate (same number as plotted in Figure 4).

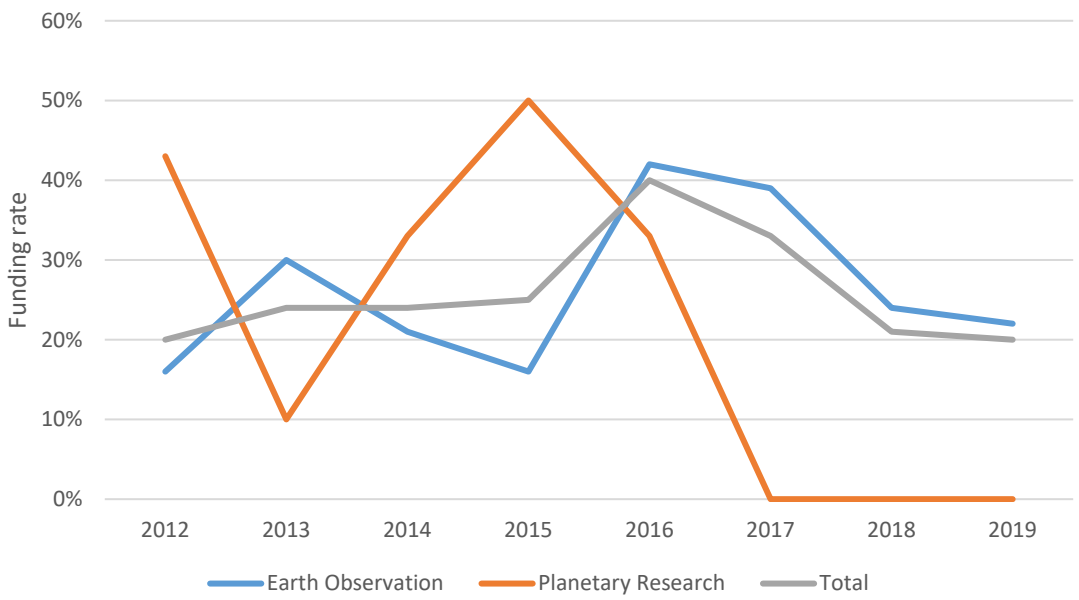

Figure 4 – Funding rates for all applications, and for Earth observation and planetary science separately.

	GO Programme 2012-2016					GO Programme 2017-2019		
Funded proposals	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Earth Observation	6 (16%)	7 (30%)	6 (21%)	5 (16%)	10 (42%)	11 (39%)	9 (24%)	9 (22%)
Planetary Research	3 (43%)	1 (10%)	2 (33%)	6 (50%)	2 (33%)	0 (0%)	0 (0%)	0 (0%)
Total	**9 (20%)**	**8 (24%)**	**8 (24%)**	**11 (25%)**	**12 (40%)**	**11 (33%)**	**9 (21%)**	**9 (20%)**

Table 7 – Number of granted proposals per year for Earth observation and planetary science. The numbers in parentheses give the funding rates (number of granted proposals / number of applications).

Appendix D – Information collected by the evaluation committee

D.1 Results of questionnaire with respect to career status GO PhDs and postdocs

On request of the evaluation committee, NSO consulted former project leaders of GO projects funded between 2012 and 2019 to inquire after the further career of the PhD or postdoc. The result is given in the table below.

Further career of PhD or postdoc (current position):	
Academic position (university or research institute):	16
Industry/Consulting related to space research:	6
Industry/Consulting (not related to space research):	4
Other/unknown:	3
Project is still running or thesis is still in progress:	48
Total	**77**

Table 8 – Reference period for the numbers is December 2020.

D.2 Earth observation versus planetary science funding rates

The number of GO applications for Earth observation research exceeds the one for planetary research. Between 2012 and 2016, the fraction of planetary science applications varied between 16 – 30%, and dropped to 9 – 15% in the period 2017 – 2019 (see Table 2). Funding rates for planetary science applications also went down in the 2017 – 2019 period as can be seen in Figure 4 and Table 7: no proposed planetary science projects received GO funding in the latter period, whereas the funding rate was between 10 and 50% in the former period.

The evaluation committee tried to get insight into how planetary science applications, as a group, were scored by the assessment committees compared to the Earth observation applications over the years. To account for the fact that the number of planetary science applications is much smaller, a statistical test[10] was performed. For each year, the average score (A_P) of all (N) planetary science applications was computed. Subsequently, a same number of N applications was randomly drawn from the set of Earth observation applications, and their average score (A_E) was calculated as well. This step was repeated 10,000 times. The resulting distribution of A_E values was then compared to the value of A_P. If the planetary science and Earth observation scores are similarly distributed, then one would expect that the peak of the simulated distribution of A_E lies near A_P: so the fraction of simulated averages A_E that is larger than A_P (let us call this fraction P_{sim}) would be ~0.5 or not far from it. If P_{sim} is very close to 1, the Earth observation applications typically score worse[11]. If P_{sim} is very close to 0, the Earth observation proposals typically score better. The test was done for the scores per criterion and for the combined score. The assessment criteria and weights for the period 2017 – 2019 varied each year and are summarized in Table 1. The assessment criteria for the period 2012 – 2016 remained the same each year and were 1) originality/innovative character, 2) scientific quality of the proposal, 3) scientific quality of the team (with equal weights).

Table 9 summarizes the P_{sim} values for each year. As can be seen, the years 2017 and 2018 stand out with P_{sim} values close to 0 for these criteria: originality/innovative character in 2018; scientific quality of the proposal and of the team in 2017; use of infrastructure and knowledge utilization in both years). In other years where originality, quality of the proposal and team and knowledge utilization were also adopted as criteria, the scores for the planetary science and Earth observation applications were more similar. The years 2017 and 2018 are the only ones considered here where '*use of space infrastructure*' was included in the assessment criteria; it was part of the eligibility check performed by NSO in other years.

[10] For the GO round 2018 only proposals that did not include an eScience component were included in the test.
[11] The NWO scoring system runs from a minimum score of 1 = excellent to 9 = poor.

Year	P_{sim}					
	Combined score	**Originality / innovative character**	**Scientific quality proposal**	**Scientific quality team**	**Use of space infrastructure**	**Knowledge utilization**
2012	0.77	0.89	0.81	0.50	-	-
2013	0.13	0.10	0.26	0.19	-	-
2014	0.91	0.84	0.90	0.85	-	-
2014	0.93	0.84	0.93	0.93	-	-
2016	0.58	0.42	0.64	0.62	-	-
2017	0.00	0.20	0.01	0.00	0.00	0.01
2018	0.05	0.01	0.22		0.02	0.02
2019	0.70	0.85		0.82	-	0.37

Table 9 – P_{sim} values for the combined score and the separate assessment criteria for the years 2012 – 2019.

D.3 Interview notes

The committee interviewed the following persons:

- ***Prof Bert Vermeersen (TU Delft / NIOZ) and Prof Wim van Westrenen (VU Amsterdam)***
  Discussed were the possible reasons that could explain the drop in success rate of planetary science proposals in the period 2017 – 2019 compared to the period 2012 – 2016 (see Section 4.1.3 and D.2). One aspect is the change in the (enforcement of) eligibility criteria after 2016. Direct use of (primary data from) space infrastructure, is an eligibility/assessment criterion that appears to be more difficult to satisfy for planetary science proposals than for Earth observation proposals. The knowledge utilization criterion appears to be more difficult for planetary research than for Earth observation.
- ***Dr Radboud Koop (NSO)***
  Discussed were the original goals and current relevance of the GO programme in the OCW space policy context, the Earth Observation Strategic Plan 2020 – 2025, the issue of valorisation of the GO programme for societal benefits, the relation to the the PEPSci programme of NWO, and the question whether the GO programme should continue to support both Earth observation and planetary research in the same way as before or differently.

Appendix E – Acronyms and abbreviations

Ariel	Atmospheric Remote-sensing Infrared Exoplanet Large-survey
CNES	Centre national d'études spatiales / National Centre for Space Studies
CNRS	Centre national de la recherche scientifique / National center for scientific research
CNSA	China National Space Administration
Domain ENW	Domain Exacte en Natuurwetenschappen / Science
DLR	Deutsches Zentrum für Luft- und Raumfahrt / German Aerospace Center
ESA	European Space Agency
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FLEX	FLuorescence Explorer mission
G4AW	Geodata for Agriculture and Water programme
GHG-CCI	Greenhouse Gas - Climate Change Initiative
GO	Gebruikersondersteuning ruimteonderzoek / National User Support Programme Space Research
GOME-2	Global Ozone Monitoring Experiment-2
ICI	Ice Cloud Imager
IPCC	Intergovernmental Panel on Climate Change
ISRO	Indian Space Research Organisation
JAXA	Japanese Aerospace Exploration Agency
JUICE	JUpiter ICy moons Explorer
KIA	Knowledge and Innovation Agenda
KNMI	Koninklijk Nederlands Meteorologisch Instituut / Royal Netherlands Meteorological Institute
MetOp-SG	Meteorological Operational Satellite - Second Generation
NASA	National Aeronautics and Space Administration
NIOZ	Royal Netherlands Institute for Sea Research
NLeSC	Netherlands eScience Center
NSO	Netherlands Space Office
NWA	Nationale Wetenschapsagenda / Dutch Research Agenda
NWO	Nederlandse organisatie voor Wetenschappelijk Onderzoek / Dutch Research Council
OCW	Ministry of Education, Culture and Science
PIPP	Partnerships for Space Instruments & Applications Preparatory Programme
PEPSci	Planetary and Exoplanetary Science programme
PLATO	PLAnetary Transits and Oscillations of stars
SBIR	Small Business Innovation and Research Space programme
SDG's	Sustainable Development Goals
STEREO	Support To Exploitation and Research in Earth Observation
TNO	Nederlandse organisatie voor Toegepast Natuurwetenschappelijk Onderzoek / Netherlands organisation for Applied Scientific Research
Tropomi	TROPOspheric Monitoring Instrument
TU Delft	Delft University of Technology
VITO	Vlaamse Instelling voor Technologisch Onderzoek
VU Amsterdam	Vrije Universiteit Amsterdam

Appendix F – Complementary (funding) programmes mentioned in the report

G4AW	The Ministry of Foreign Affairs' Geodata for Agriculture and Water (G4AW) programme uses Earth observation data for societal applications that contribute to the UN's Sustainable Development Goals. https://g4aw.spaceoffice.nl/en/
InCubed	ESA's InCubed programme focuses on developing innovative and commercially viable products and services that exploit the value of Earth observation imagery and datasets. https://incubed.phi.esa.int
NPP	The Netherlands Polar Programme (NPP) funds scientific research into and in the polar regions. On behalf of the Netherlands, the programme wants to contribute to solutions for fundamental scientific and socio-political issues, such as the consequences of climate change. https://www.nwo.nl/en/researchprogrammes/netherlands-polar-programme
Origins Center	The Origins Center was established with funding from the Nationale Wetenschapsagenda with the goal of developing an interdisciplinary research network with a focus on studying the origin of life on Earth and in the universe. https://originscenter.nl
PEPSci	The goal of NWO's Planetary and Exoplanetary Science (PEPSci) programme is to strengthen the position of planetary and exoplanetary research in the Netherlands by establishing a coherent and integrated network on the interface of astronomy and Earth sciences. There have been two PEPSci funding rounds (2013, 2019). The ultimate goal is to prepare the Dutch planetary research field for its future participation in the Nationale Wetenschapsagenda (NWA) programme, after which the PEPSci programme itself will be discontinued. https://www.nwo.nl/en/researchprogrammes/pepsci-planetary-and-exoplanetary-science-programme-0
PIPP	The aim of the NSO/NWO Partnerships for Space Instruments & Applications Preparatory Programme (PIPP; Kennisnetwerkenregeling in Dutch) is to advance the international position of the Netherlands in the area of the development and use of space instruments, by supporting expertise networks. https://www.spaceoffice.nl/en/support/pipp-programme/
SBIR	The NSO/RVO Small Business Innovation and Research (SBIR) Space scheme is a programme to encourage the use of satellite data by government bodies. https://www.spaceoffice.nl/nl/ondersteuning/sbir/
STEREO	The Belgian Support To Exploitation and Research in Earth Observation (STEREO) programme, managed by the Belgian Science Policy office, offers to Belgian universities, public scientific institutions and non-profit research institutions opportunities and tools for the development of an expertise in Earth observation and a maximized scientific use of satellite and airborne data. https://eo.belspo.be/en/stereo-in-action