NASA INTERNATIONAL SPACE APPS CHALLENGE 2018 IN TARTU

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Figure 1: Event logo (by Raivo Aunap, Dept. of Geography)

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Executive Summary

The Department of Geography, the Institute of Computer Science and the Tartu Observatory jointly organised and hosted a 48h hackathon event as part of the 2018 International NASA SpaceApps Challenge. This global event happened on the weekend 19.-21. October 2018 at more than 200 locations, 75 countries, world-wide over the course of the weekend, with Tartu as the only Estonian location.

Space Apps is a two-days international hackathon that occurs in cities around the world, globally coordinated by NASA. It is an annual event that pulls citizens together regardless of their background or skill level to address challenges we face on Earth and in Space. Project teams were formed to work on specific topics that they either developed themselves or were suggested by sponsors, the panel or ourselves. The teams' results were then presented and judged by a panel at the end of the event.

From overall 58 registrations initially, we eventually had 7 teams formed from 35 participants. We raised ca. 1200 EUR from external sponsors, and 4700 EUR internally (Table 2). 4000 EUR of the internal contribution, provided by Tartu Observatory, is designated to support the first price: Flights, accommodation and attendance fee for the winning team to participate in the ESA Living Planet Symposium, 13-17 May 2019, in Milan, Italy. The winning team has prepared an abstract for a poster submission to present their project on the conference.

Figure 2: Teams working during the hackathon in one of the dedicated working spaces

The main goal was to provide a safe platform for motivated students from various backgrounds to work together on real problems in a hackathon event, while at the same time learning the benefits of interdisciplinary work, combined team work with different skills. The second goal was to foster networking between the research institutes and the geospatial industry in Tartu, and expose students to the field of geospatial and Earth Observation (EO) applications.

Overall it can be concluded that this was a very successful event: the teams developed substantial solutions and got engaged with industry and entrepreneurship; inter-departmental and inter-sectoral networks for the research institutes have been strengthened in particular between the organising institutes and with the Tartu Science Park/ESA Business Incubator and several leading innovative (geospatial) software companies.

What is NASA Space Apps and what makes it special?

NASA Space Apps Is the world's largest hackathon: https://2018.spaceappschallenge.org/

Table 1: NASA SpaceApps by numbers (NASA)

	2013	**2014**	**2015**	**2016**	**2017**
Participants	9000	8200	13000	16000	25000
Locations	83	95	133	161	187
Countries	44	47	-	-	69
Solutions	770	671	949	1300	2000+

Space Apps is an international hackathon that occurs over 48 hours in cities around the world (Fig. 3). Coders, scientists, designers, storytellers, makers, builders, technologists, and everyone enthusiastic about curiosity come together to address challenges we face on Earth and in space!

Figure 3: Map of all cities/locations, where a NASA SpaceApps local event was hosted this year (NASA)

It is not just about apps! Worthwhile projects include using data visualisation, hardware, design and many other specialities. Participants are encouraged to approach challenges by Inspiring each other while learning and creating via means of stories, code, design and, most of all, letting ideas flourish. Using creativity, skills and knowledge, in order to solve some problem that is relevant either for them, their country or for the whole world!

As part of the annual event NASA also preselects a variety of topics, that the teams should relate their projects to. This year's "challenges" were:

- [HELP OTHERS DISCOVER THE EARTH](#)

- [CAN YOU BUILD A...](#)

- [VOLCANOES, ICEBERGS, AND ASTEROIDS (OH MY)](#)

- [WHAT THE WORLD NEEDS NOW IS...](#)

- [AN ICY GLARE](#)

- [A UNIVERSE OF BEAUTY AND WONDER](#)

The final result, the solution, can be not only an app, but could also be a new dataset, a new method, a video or other story-telling approach. This hackathon format is different from the currently more prevalent technical business- and product-oriented hackathons in Estonia, like the popular Garage48 hackathons.

We also created an event website with the Sisu@UT webpage system at the University of Tartu, where we collated all information necessary for prospective participants: https://spaceapps2018.ut.ee

Organisation and Funding

Event organisation team

Main organisers (4):

Alexander Kmoch, PhD (researcher GEOG[1]), Evelyn Uuemaa, PhD (senior researcher GEOG),

Laura Altin (PhD student in Geography, Marketing and Communication Specialist ATI[2]),

Merli Ilves (MSc student Geography, President of EGEA[3] Tartu Chapter)

Volunteers (9):

Selim Bayraktar (visiting PhD student GEOG),

Liza Vabištševitš, Marlen Paris, Hendrik Neubauer, Sigrid Paavle, Maria Kolk, Karoliina Kurvits (MSc students Geography and EGEA members),

Salijona Dyrmishi, Samreen Mahak Hassan (MSc students Computer Science ATI)

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[1] GEOG: Department of Geography, University of Tartu
[2] ATI: Institute of Computer Science, University of Tartu
[3] EGEA: European Geography Association, Tartu chapter

Financial summary

Table 2: External and internal sponsoring and budget summary (organisers underlined and italic)

Company/Institution	Funding pledged	Actual spending
Tartu Observatory (UT)	4 000,00 €	main prize (in preparation)
CGI	400,00 €	t-shirts (406 EUR)
ATI (UT)	400,00 €	gift bags, stationaries / food (275 EUR, rest available to teams if required), mentoring
Datel	300,00 €	Pizza (300 EUR)
Cybernetica	300,00 €	Pizza (300 EUR)
Geograafia osakond (UT)	300,00 €	stickers/food (298 EUR)
Tartu linnavalitsus	200,00 €	lunch at Hector Café for all participants (150 EUR), and Säde Cafe vouchers for 2nd place (50 EUR)
Positium	100,00 €	soft drinks (68 EUR)
Institute of Ecology and Earth Sciences (UT)	In-kind	Costs for security staff for the extended opening hours for the building
ESA incubation centre / Tartu Science Park	In-kind	mentoring, panel, guidance to ESA/BIC incubation for successful teams
Taarapõllu talu		berrychips for giftbags
Poko		5 Pokobags for giftbags

Attendees and their roles

Hackathon participants

We aimed for a maximum of 50 participants. At the start of the event we had 46 registrations but 35 attending participants - mainly students, mostly but not exclusively from the University of Tartu from at least 15 different countries of origin (Fig. 4). As all on-site participants had to be registered with NASA, we ended up with 58 registrations. This indicated that up to 12 participants arrived without former registration, and of course not all people came that had registered in the first place.

Most participants were students, BSc, MSc and PhD students, from the University of Tartu; 3 participants came from Riga Technical University; 1 student came from Turku. At least 4 participants came from different companies or other external organisations in Tartu. Within Tartu University, students came with various backgrounds, with large portions from Department of Geography, Institute of Computer Science, and Science and Technology. Furthermore, we had participants from Social Science, Business Administration and Environmental Technologies.

Figure 4: The map shows the countries of origin of the participants. The word cloud visualises the relative number of participants originating from same countries.

Mentors

We could win several mentors who agreed to be available to the teams during the event for technical questions, consulting and coaching in order to produce the best possible results.

- Martin Jüssi (CGI Estonia), interdisciplinary space studies and geoinformatics, incl. business perspective
- Andris Slavinskis (Tartu Observatory, NASA Ames Research Centre, EstCube), space technology research, nanosatellites, nanospacecraft, small interplanetary missions design and asteroids
- Maria Angelica Medina Angarita (ATI), Human-Computer Interaction, graphic design
- Siim Karus (ATI), business intelligence and business process management

Panel and judgment criteria

At the end of the hackathon the teams present (i.e. "pitch") the results of their projects to the panel. This part of the event was public again and we had also guests from outside the event.

We prepared scorecards for the panel in order to evaluate each team's performance in regards to following criteria, which were also promoted by NASA:

- Impact
- Creativity
- Validity
- Relevance
- Presentation
- Local / Global

We designated internal members of the organisers' units within the University of Tartu and Tartu Observatory, as well as reaching out to various agencies and companies from Tartu and whole Estonia. As highlights we could win (Fig. 5):

- Villem Alango (PhD), who held roles as Senior Expert with the e-Governance Academy and co-founder of Datel. His expertise includes human aspects of e-society of and communicating with different audiences;
- Sven Lilla from the Tartu Science Park, who works every day with the ESA Space Business Incubator program at the Tartu Science Park;
- and also Martin Jüssi, the GIS and Earth observation account manager of CGI Estonia.

Further members on the panel agreed to be:

- Mait Lang (PhD), Senior researcher at University of Tartu, Tartu Observatory, Associate Professor at the University of Life Sciences;
- Prof. Sherif Sakr, Head of Data Systems Group at the Institute of Computer Science, University of Tartu;
- Prof. Tönu Oja, Professor of Geoinformatics and Cartography at the Department of Geography, Tartu University and Geoinformatics Head of Chair;
- and also Maria Angelica Medina Angarita, who works as an assistant for the Human-Computer Interaction class at Tartu University;

Figure 5: Panel members in order from left to right, V. Alango, S. Lilla, M. Jüssi, M. Lang, S. Sakr, T. Oja, M. A. M. Angarita

What happened on the Event?

Program

Friday, 19th of October:

At 5:00 pm we opened the check-in for participants, and at 6:00 pm we started the Welcome session: All gathered in the main auditorium. We started with some introductory words, explain the general program, the available locations and important housekeeping notes for the weekend.

As part of the Welcome session we had three short presentations:

Starting with Prof. Jaak Vilo, Head of the Institute of Computer Science, who gave a shout-out to the fruitful interface between domain sciences and programming and offered the computing resources of the University of Tartu HPC to interested teams. Followed by Martin Jüssi, the GIS and Earth observation account manager of CGI Estonia, who discussed the value of freely available satellite data and how applications of remote sensing can solve various challenges on Earth.

Figure 6: Event Kick-off at the big auditorium in Vanemuise 46, Institute of Ecology and Earth Sciences

Finally, we had a live Skype call with a NASA scientist, who has also worked at Tartu Observatory and on ESTCube: Andris Slavinskis (Fig. 7). His presentation was titled "Riders on the Solar Wind: Multi-Asteroid Touring". It was a great overarching theme, with topical introductions on looking down on Earth, looking into space, and computer-processing the data for problem solving.

Figure 7: Andris Slavinskis, NASA Ames Research Centre & Tartu Observatory

We introduced the mentors, who would be around on 20th and 21st for about 2 hours per day and gave feedback about the work that teams have been doing. Martin Jüssi was around a lot of time, and Andris Slavinskis was available via Skype and email.

Then suggested topics are presented in short pitches. Several topics were brought in by participants, and several were proposed by sponsoring companies or from UT scientists.

Teams had to comprise of people with different complimentary skills and have at minimum 3 up to 5 (in exceptional cases maybe 6) members. Eventually, from all pitched ideas, 7 teams could be formed successfully and we formally announced the start of the hacking time!

On Friday and Saturday evenings the building (Vanemuise 46) had to be locked by 11:00pm and participants had to leave and were encouraged to get some sleep. On the mornings of Saturday and Sunday it was reopened at 8:00 am to the participants again.

Saturday, 20st of October was completely dedicated for hacking.

During the course of the event, the raised funding from sponsors was used to arrange food and drinks. Snacks, fruits and sandwiches were made available throughout the event, prepared by the volunteers. Friday and Saturday dinners were pizza deliveries, and Saturday and Sunday lunch was soup at the Hector's Café.

Sunday, 21st of October

Around 12:00 noon we gave the teams a short upgrade on their pitching skills with a short presentation on things to consider to make the final presentation (the pitch).

4:00 pm (Final presentations and awards ceremony): All work had to stop, teams had to upload their results to public repositories like GitHub and update their dedicated NASA Space Apps project websites.

Everybody gathered in the main auditorium again. The teams then presented their results in fascinating captivating final presentations. Each team had a presentation of 3 to maximally 5 minutes. After the presentations the panel convened and graded all the teams by their presentation and results.

After the decisions were made the two winning teams were revealed and the prizes and certificates presented to the teams and the event concluded.

What are the Hackathon Outputs?

Team Projects

On the NASA Space Apps hackathon website, each hosting location got an own page for outreach and in order to present the projects of their 7 teams:

https://2018.spaceappschallenge.org/locations/tartu

- 1st price winning team "ViralSAT", project about corwd-sourcing social media disaster-related images in order to improve satellite data assessment for affected areas, has already submitted abstract to the ESA Living Planet Conference
- 2nd team, Stargazing, developed an app design for better stargazing location finding, taking into account various datasets like light pollution etc.
- both 1st and 2nd team have been promoted to the NASA global competition, results still outstanding
- both teams have also been engaging with the Tartu Science Park/ESA Business Incubator program
- teams "Milky Way" and "Starships" both worked on sponsor-related ideas, both teams have engaged with the companies in order to present their results, this has been well received by the companies
- team "Satify" developed a knowledge base for the various Earth observing satellites in order to make it easier for users of satellite data to better decide which satellites' data to use based on sensor properties pixel size, sensors (radar, spectral bands …), pass-over times, swath size etc.
- teams "Fleacho" and "Ground Support Crowd" had designed technical plans for hardware development

Media Outreach

Photos from the Event, by Marko Mägi (UT):

https://www.flickr.com/photos/152045181@N05/43614677870/in/album-72157702423969164/

Event-related posts on social media (especially on Twitter, Facebook and Instagram) we advertised to participants to use:

Twitter handles and hashtags: #SpaceAppsTartu @unitartu @UniTartuCS @spaceapps #SpaceApps

Facebook (Facebook event page: https://www.facebook.com/events/302039357192792/) and Instagram tagged #SpaceAppsTartu.

Photos selections from the event posted on social media (Facebook):

- https://www.facebook.com/geograafia/photos/pcb.310533859676675/2412168228823127/
- https://www.facebook.com/geograafia/photos/pcb.311687239561337/2417498088290141/
- https://www.facebook.com/ut.ics/photos/pcb.310893529640708/10161052117200603/

The event made it into National news television ETV Aktuaalne Kaamera:

Figure 8: ETV news section linked from Novaator (https://novaator.err.ee/871402/nasa-hakatoni-voitja-lubab-sotsiaalmeedia-abil-satelliitpilte-taiustada)

Overall event discussion and conclusion

Goals set out:

The main goal was to provide a safe platform for motivated students from various backgrounds to work together on real problems in a hackathon event, while at the same time learning the benefits of interdisciplinary work, combined team work with different skills. When discussing the idea of hosting such an event with Geography students, we received mixed opinions. In summary, students, which are

not stemming from Computer Science and who are not so in touch with the "tech" (or start-up) scene are apprehensive to attend classical tech/app hackathons. They believe that they don't have abilities/skills to contribute in such settings, if they aren't programmers. This misconception was an important facet to overcome in order to get (eventually) domain specialists more involved early on and expose students to the field of geospatial and Earth Observation (EO) applications.

The second goal was to foster networking between the organising research institutes and the geospatial industry, business and technology environment in Tartu. Better inter-sectoral collaboration is of mutual benefit, exploiting science outputs and creating business value and making sure that Tartu continues to be a leading innovation hub.

Goals achieved:

Overall it can be concluded that this was a very successful event. The teams developed substantial solutions and got engaged with industry and entrepreneurship.

It was refreshing and encouraging to see the diversity of participants, culturally, geographically as well as their varying educational and professional backgrounds. This hackathon was different from traditional tech/app/product-oriented hackathons, especially In Estonia. There were a lot of domain experts, and much less programmers and developers than "usually". The challenge for them was to come together over a joint idea, combining their strengths and skills of different roles in order to produce something meaningful and valuable over the course of the weekend.

A particular challenge was finding consensus and compromises in their project design and decision making processes, while speaking different languages - not only in the literal sense (English was the main working language), but also in a professional sense. Students learned that it needed some effort and awareness to understand someone else's background and perspective in order to reconcile ideas and features between science experts, business and design people, and programmers. Participants reported this as a very positive educational impact for them during and after the event. They valued the good working conditions, the diversity of the participants and project topics, but also experiencing the exposure to the tight problem-solving conditions of a hackathon.

Figure 9: Winning team ViralSAT (right) at price-giving, price handed over by Dr. Mait Lang from Tartu Observatory (2nd from left)

Also, the inter-departmental and inter-sectoral networking between the research institutes have been strengthened by the joint organising efforts. In addition, connections between the organising institutes and with Tartu Science Park/ESA Business Incubator and the geospatial software industry in Tartu have been improved.

Main challenges, what to improve, lessons learned:

A major let-down were the multimedia and audio-visual event capabilities of the main auditorium in Vanemuise 46. We aimed to record and live stream the event opening on Friday and the final presentations and award ceremony on Sunday, but this didn't work very well. Also, raising funding and event organisation was time-intensive and should have started earlier. However, the application period for NASA SpaceApps is rather late (August) and we waited until acceptance (September) in order to move forward. With the experience from this event now, I believe we can be confident to move earlier without waiting to be accepted, in case we apply again.

The Pitching training was received as very important and effective for the teams to improve their communication and presentation abilities. This could be planned with an expert next time.

Having to lock the building at night came with advantages and disadvantages: It was actually good for the performance of the students to be "forced" to leave and get some sleep. However, it was needed to plan accommodation for several visiting students from other locations because they couldn't stay at the event location. Sleeping at the event is rather typical for 48h hackathons and participants sleep a few hours "under the table".

Sustainability of the event and the event outcomes:

Many teams had follow-up activities which strengthened bilateral engagement with the sectors - science and industry - for students, researchers and (GIS/Geospatial and EO) software companies. In particular, we would like to highlight the mutual benefits for Tartu Science Park/ESA BIC and us of jointly continuing the activities around EO projects and jointly planning of next year's NASA hackathon.

Thank You!

Figure 10: We thank all of the sponsors, supporters, and volunteers, who made this event not only possible, but a great success.