INTERNATIONAL® SPACE UNIVERSITY

SPACE STUDIES PROGRAM

June - August 2018 The Netherlands

RETROSPECTIVE 2018

#SSP18 #NLARGEYOURUNIVERSE

esa

TU Delft

Universiteit Leiden
The Netherlands

DIRECTOR'S RETROSPECTIVE

Compared to previous years, the 2018 Space Studies Program was characterized by diversity and creativity.

For the first time ever, ISU was hosted by three different institutions, TU Delft, Leiden University and European Space Research and Technology Centre (ESTEC). This program also attracted the highest number of participants, 135 from 36 different countries.

Despite the growing number, participants preserved the opportunity to closely interact with each other and immerse themsel- ves in a world class education and professional development.

We invited the highest number of visiting lecturers this year, reaching aratio of 2 lecturers per participant. In addition, with 57 different workshop, theparticipants had the largest portfolio of workshops to choose from and exposed themto a wide range of topics. The activities were not only restricted to the Netherlands, but expanded across the borders to Belgium, Luxembourg and Germany, taking advantage of being in the middle of Europe.

9 weeks ago, we were warmly welcomed to the Netherlands, by none other than the Dutch king, his Majesty Willem-Alexander of the Netherlands at the opening ceremony. Since then time has flown by. Participants have heard Core Lectures fromastronauts, space agency heads and experts from around the world. They have been through the departmental phase, and finished four team projects.

This year's team projects included; Space-Aided Climate Change Adaptation: Floods and Air Quality Management, Lunar Nights: Survival, Active Space Debris Removal Based On Eco-Design Approach, Weather Forecasting & The Power Industry: Smallsat System For Energy Providers And Consumers. Each of these Team Projects represented a different challenge and taught the participants how to work together in a complex, international, intercultural, and interdisciplinary environment.

Involving participants in an International environment, augmented by multiple cultural views, empowered by the ability to capitalize on multiple intellectual disciplines, has been one the core philosophies of the SSP.

What participants have learned throughout the course of the program will provide them with the tools, the capability, and the motivation to confront and to conquer the challenges the future will present.

Participants have been on an intense journey together, getting to know each other, learning from each other and growing with each other.

They have connected through shared academic achieve- ments, social gatherings and cultural experiences, creating lifelong memories and friendships.

I wish you all the luck on your future endeavors, and look forward to connecting again in the future!

Dr. Omar Hatmaleh
Director, ISU Space Studies Program

INTERNATIONAL SPACE UNIVERSITY

Very few universities possess a spirit as innovative and visionary as the International Space University (ISU). As its name conveys, two of the underlying tenets of the university are its international spirit and specialization in space. Established in 1987 at a founding conference at the Massachusetts Institute of Technology (MIT), ISU has since become the world's leading institution in the specialized fields of the space sector.

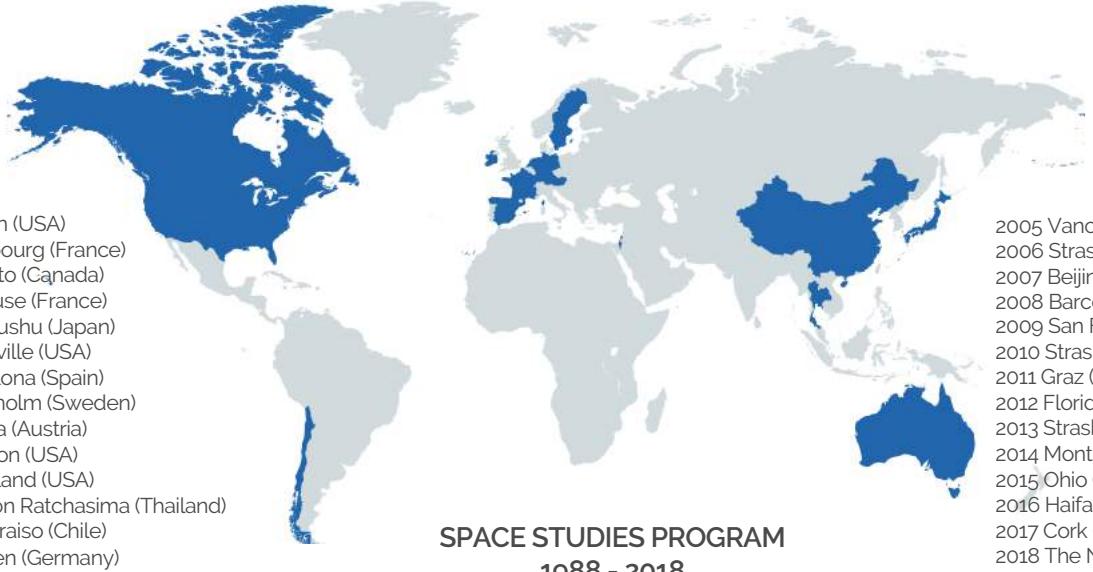
ISU offers a unique brand of space education that is sought after by space agencies, the private sector and research institutions worldwide. True to its founding principles, the education at ISU revolves around the three "I"s —International, Interdisciplinary, and Intercultural. Over the past 30 years, more than 4,400 students from over 100 countries have graduated from ISU.

SPACE STUDIES PROGRAM (SSP)

ISU offers several programs targeted at different demographics, from short term executive programs to a one- or two-year Master's program. The Space Studies Program (SSP), though, is the long-standing, pioneer program of the university. It is a graduate level professional development program conducted by ISU since 1988. The curriculum covers principal space related fields that are both technical and non-technical. The program itself covers a range of subjects from policy and law, to business and management, humanities, life sciences, engineering, human and physical sciences, space applications. The shared experience of an international, intensive, and interactive working environment is an ideal networking forum leading to the creation of an extensive, international, multidisciplinary professional network.

The SSP takes place in a new location every year and exploring a new host country brings an added dimension to SSP's internationally-oriented education. The International Space University was pleased to bring its Space Studies Program—for the first time—to Delft in the Netherlands. The program was conducted out of the Delft University of Technology in collaboration with Leiden University and for the first time in partnership with ESA through the European Space Research and Technology Centre in Noordwijk.

1988 Boston (USA)
1989 Strasbourg (France)
1990 Toronto (Canada)
1991 Toulouse (France)
1992 Kitakyushu (Japan)
1993 Huntsville (USA)
1994 Barcelona (Spain)
1995 Stockholm (Sweden)
1996 Vienna (Austria)
1997 Houston (USA)
1998 Cleveland (USA)
1999 Nakhon Ratchasima (Thailand)
2000 Valparaiso (Chile)
2001 Bremen (Germany)
2002 Pomona (USA)
2003 Strasourg (France)
2004 Adelaide (Australia)



SPACE STUDIES PROGRAM
1988 - 2018

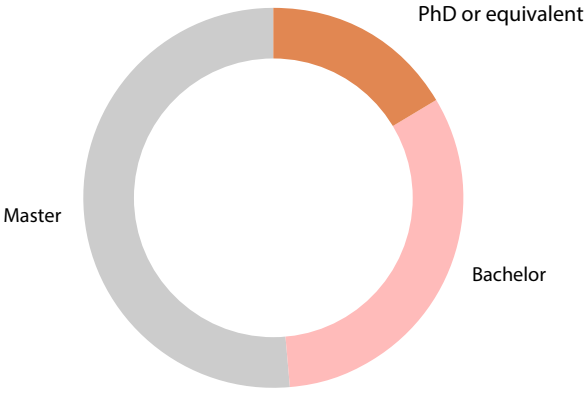
2005 Vancouver (Canada)
2006 Strasbourg (France)
2007 Beijing (China)
2008 Barcelona (Spain)
2009 San Francisco (USA)
2010 Strasbourg (France)
2011 Graz (Austria)
2012 Florida (USA)
2013 Strasbourg (France)
2014 Montreal (Canada)
2015 Ohio (USA)
2016 Haifa (Israël)
2017 Cork (Ireland)
2018 The Netherlands
2019 Strasbourg (France)
2020 Shenzen (China)
2021 Granada (Spain)

FACULTY AND STAFF

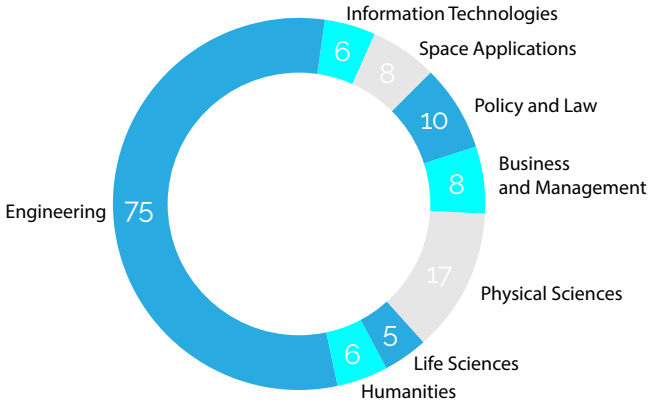
SSP18 invited approximately 250 top experts from around the world to share their professional knowledge with the program. This year's faculty and distinguished lecturers include astronauts Jeffrey Hoffman and André Kuipers, Chairman for the Breakthrough Prize Foundation Simon Pete Worden, Program Executive for Mars Exploration at NASA George Tahu and Deputy Director of the International Institute of Air and Space Law at Leiden University Professor Tanja Masson-Zwaan.

PARTICIPANTS

SSP18 had the second highest number of participants to date with 135 individuals representing 34 different countries. 55% of participants came from an Engineering background and 18% have PhDs in their respective fields.



Educational Level



Educational background

Alex Ryan
Participant Liaison from Australia

Having only ever done the Southern Hemisphere Space Studies Program as a participant and TA, I just couldn't say no when the director of SSP Omar Hatamleh asked me to come to the Northern Hemisphere as the Participant Liaison. What a fantastic decision that was! Over the past nine weeks I have had the utmost pleasure of working with 135 participants, helping them and organising fun activities like Culture Nights and Talent Nights; my overall experience of SSP18 has been amazing.

What I've really enjoyed the most is getting to meet so many new people, hearing about their experiences and passions. Every participant, staff member, and lecturer brings their own excitement and enthusiasm about the space world, and ISU is such a nurturing place for these feelings.

I've had a huge amount of fun and to anyone thinking of coming to ISU, just do it!

WHAT DO PARTICIPANTS GAIN FROM SSP?

International exposure:

SSP offers participants the opportunity to meet with the space industry's top experts, leading scientists and administrators from space agencies, private companies, nonprofit organizations and research institutions from around the globe. While this gives them unprecedented access and exposure like no other, participants also gain a personal connection with the space industry's world leaders.

International, interdisciplinary teams:

SSP groups and teams combine participants from all national, professional, and educational backgrounds to develop the skills required to work in global teams. Bringing together these diverse perspectives creates a rich environment in which peers can learn from one another to accomplish common goals.

Knowledge in all fields of the space sector:

For nine weeks, participants are exposed to all major fields in the space sector, including engineering, science, applications, policy, economics, law, management, business, arts, and life sciences.

Cultural exchange:

Living and working with fellow participants from around the globe provides everyone an appreciation of different cultures, which is critical in today's industry - dependent on international cooperation.

Networking for life:

The SSP experience doesn't stop after SSP ends. Years, decades after their SSP, participants acquire a wealth of opportunity through a network of alumni scattered all across the globe. This gives the SSP participants better opportunities within the space sector.

Cian O'Regan
Participant from Ireland

"Before arriving in Delft, I must admit my expectations for the Space Studies Program were pretty high after gaining a sneak peek into life in the space mafia when SSP17 took place in Ireland. After nine weeks in the Netherlands, I can honestly say that SSP18 was by far and away the greatest experience of my entire life so far! Between having lunch with a Hubble repair man, observing a pulsar with the Space Sciences department and conducting a lunar analog mission at the European Astronaut Centre with our Team Project, it will take me a very long time to fully comprehend the awesomeness of our SSP18 experience. However, without doubt the greatest thing about SSP are the people. I am eternally grateful for the time I have been able spend with my fellow participants and the staff. What I am most looking forward to taking home from my time at SSP and reflecting on in the years to come are the wonderful relationships I have forged with people who were once complete strangers to me, and who I now consider to be my greatest friends."

CURRICULUM

The interdisciplinary SSP curriculum emphasizes international cooperation and provides participants with varied perspectives on the world's space activities. The program includes lectures by renowned experts, hands-on activities and projects, teamwork exercises, and professional visits. Each year it evolves to better meet the needs of its students and their employers. There are three phases to SSP: Core Lectures, Department Activities, and Team Projects. All course work at ISU is conducted in English.

CORE LECTURES

The 57 core lectures covered the fundamentals of all major space topics with a focus on Applications (APP); Engineering (ENG); Management and Business (MGB); Policy, Economics and Law (PEL); Sciences (SCI); Humanities (HUM); and Human Performance in Space (HPS). The interdisciplinary (INTER) lectures covered a combination of these areas to emphasise the relationships between these disciplines. The lectures are designed primarily for non-experts to make them accessible to participants from any academic background.

Jana Stucke
Participant from Germany

"The SSP18 was an amazing experience. I have met so many interesting, kind and most important inspiring people. The conversations I have had during the program with participants as well as with experts from industry made the SSP extremely valuable to me. The SSP taught me the most outside the lecture hall by working together with people from different nationalities. As an aerospace engineer with specification in sub- and supersonic aerodynamics I did not have the strongest connection to the space sector. However, after having attended the SSP this has changed and I am considering doing the MSS straight after I have finished my PhD."

Yanina Hallak
Participant from Argentina

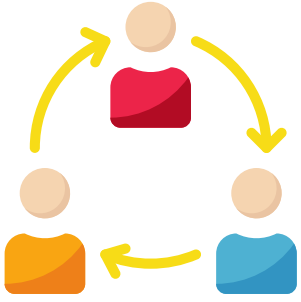
"SSP is a program without borders, where people from all over the world meet for the same reason, to celebrate Space. I am grateful for this huge opportunity that ISU has given me, and happy to have met people from more than 35 countries and with completely different backgrounds that have taught me to look at Space from different points of view, beyond engineering, if you want to live the most spacey summer of your life, Join ISU ... where Space is for everyone."

Ts. Nyamkhuu
Participant from Mongolia

I am really excited to be here in the SSP2018 of ISU at the TU Delft, NL as the first participant from Mongolia. The program was so amazing that it covers all fields of space study including both academic and practical contents as well as fun professional visits in space facilities within the European union. I believe without hesitation that it will help Mongolia to advance its space agenda significantly, and I assure you I will work towards it when I am back to the home country.

DEPARTMENTAL ACTIVITIES

The Department Activity phase provides time for deeper examination of some of the topics covered in the Core Lectures. Groups are smaller, allowing for a greater exchange of knowledge and ideas as well as hands-on activities. Departmental weeks are an important opportunity for participants to interact with faculty members, lecturers, and teaching associates and to build their professional networks.



SPACE HUMANITIES
Co-chair : Ruth McAvinia
Co-chair : Niamh Shaw
TA : Thomas Mueller

HUMAN PERFORMANCE IN SPACE
Chair : Heather Allaway
TA : Courtney Patterson

SPACE ENGINEERING
Chair : Joseph Pellegrino
Associate Chair : Cory Newman
TA : Chaitanya Gopal

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SPACE POLICY, ECONOMICS AND LAW
Chair : Christopher Johnson
Co-chair : Andrea Harrington
TA : Dillon O'Reilly

SPACE SCIENCES
Chair : Eric Dahlstrom
TA: Hilda Palencia

SPACE APPLICATIONS
Chair : Dr. Su-Yin Tan
TA : Amanda Michelle Simran Sathiaraj

SPACE MANAGEMENT AND BUSINESS
Chair : Adil Jafry
TA : Evelina Onopriyenko

TEAM PROJECTS

During SSP18, a total of 144 Team Project slots is allocated for four Team Projects.

TP – Lunar Nights Survival

Team Project Chair:	Rob Postema
Team Project Associate Chair:	Matthew Sorgenfrei
Teaching Associate:	Antonio Martelo

DESCRIPTION OF THE TP:

At present, there is an increasing number of interested parties in deploying activities on the Moon. This wide interest of the space community, and the potential of developing a variety of activities that are fundamentally different from earlier lunar exploration missions, opens the door to developing supporting services in areas such as communication, thermal control, and power supply, suppressing the need to have self-contained missions as has been the case until now.
"TP-Lunar will propose a scalable power generation and distribution system for utilization during lunar days and nights to enable a sustained presence on the moon."

In support of this clear and concise mission statement, TP-Lunar will propose a scalable solution to address the early, intermediate and long-term needs of future moon activities, such as science research, commercial and manned activities, or a permanent settlement on the Moon.

TP - WEATHER

Team Project Chair: Jan Walter Schroeder

Teaching Associate: Anna Wojdecka

Power companies need to predict power consumption and peak loads in advance to avoid purchasing electricity at high prices in the short term. Weather forecasting plays an important role in the energy industry, specifically in the renewable energy sector, and can be used to predict loads early enough to avoid surplus costs. However, with current satellite weather data and prediction models, energy companies can only determine mid-term trends, and would require more accurate and frequent forecasting to solve the issue on hand.

TP Weather will analyze the market to understand the need of more accurate weather predictions, specifically in the renewable energy sector, and how the use of weather forecasting can be optimized and improved to serve the needs of the energy sector. This will be done through a structured division of the team that will individually focus on the business segment, weather data analysis, upstream and downstream satellite technology, and policy, law and societal aspects. At the end of the project, TP Weather will recommend a solution that will utilize space-based weather forecasting system.

The purpose of this document is to provide the team and their stakeholders with a clear vision for the project. The document outlines the justification and scope of the project, the aims and objective, the team structure, the work breakdown structure, a risk analysis outline and the project schedule until the deadline for the final report.

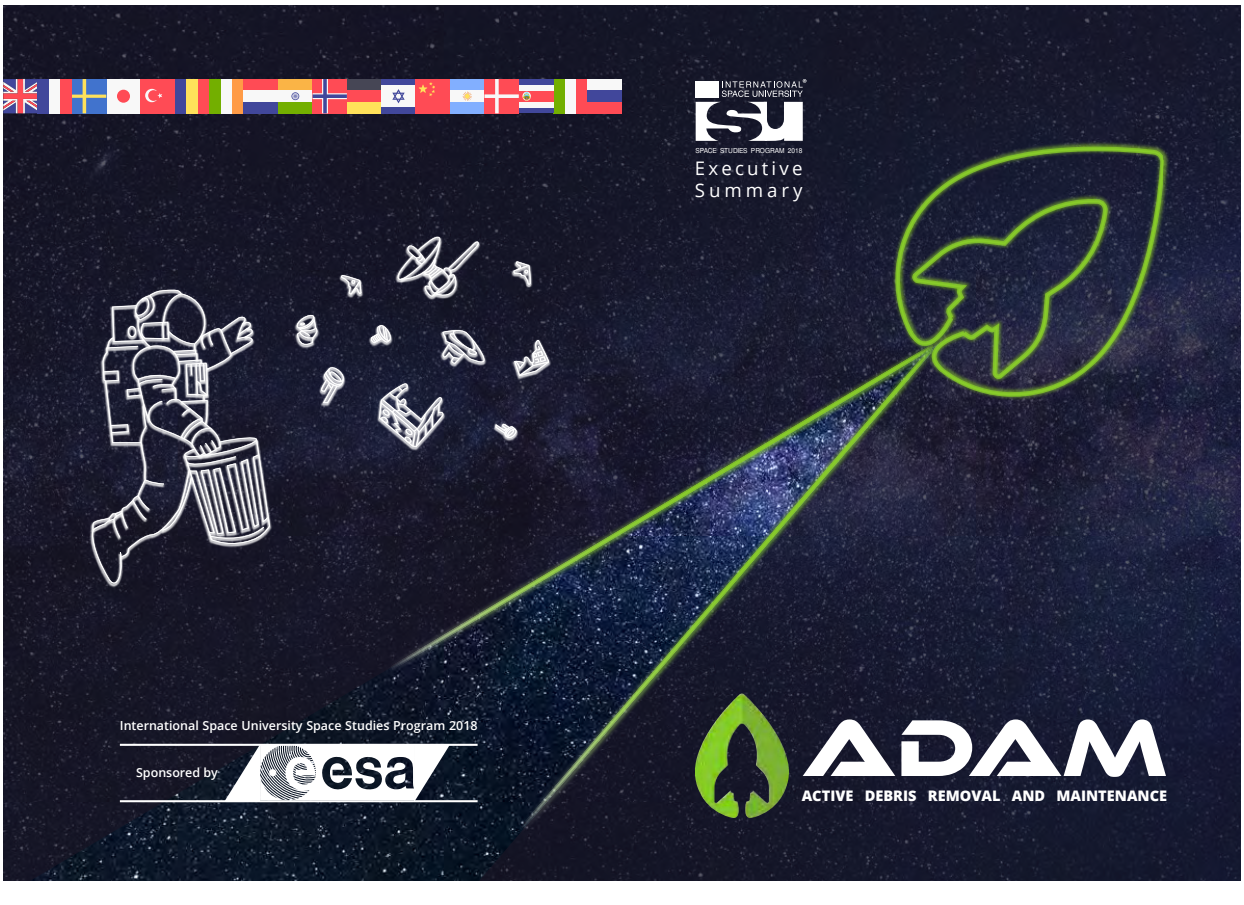
TP - SPACE DEBRIS

Team Project Co-Chair:	Ruediger Jehn
Team Project Co-Chair:	Olga Zhdanovich
Teaching Associate:	Pierre Evellin

Space debris is a growing hazard for space assets. Some of the orbits are already crowded with different types of debris, raising significantly the risk of collision with operating spacecraft.

The Team Project Debris (TP Debris) is focused on the reduction of space debris through active debris removal activities, such as on-orbit servicing to prolong the life of existing structures, physical removal of debris from target orbits, and designing for the future with eco-designed missions. The TP Debris will also provide building blocks for a sustainable business and legal framework to ensure the successful implementation of the proposed activities.

The TP Debris received the support from ESA ESTEC expert on mission analysis, propulsion, thermal control, power and other subsystems to design a mission though concurrent design. The focus of their study is put on the Eco-design, aiming at minimizing the environmental impact of the debris removal missions.



TP - CLIMATE

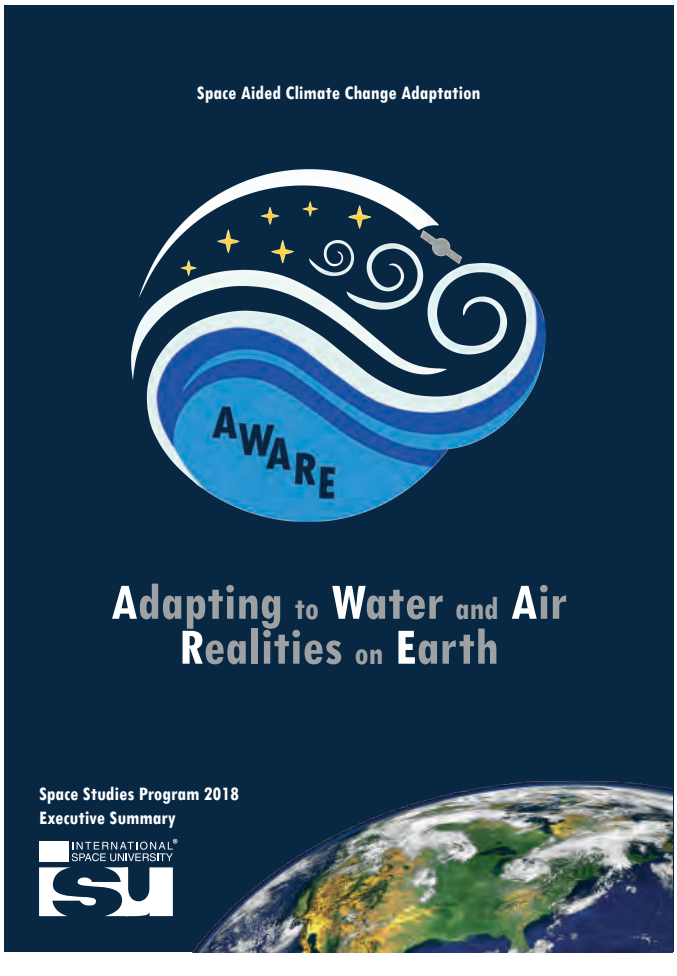
Team Project Co-Chair:	Daniel Garcia Yarnoz
Team Project Co-Chair:	Erik Laan
Team Project Associate Chair:	Irina Thaler
Teaching Associate:	Siobhan O'Neill

TP on space-aided climate change adaptation with a focus on air quality and flood management; issues that are of particular interest for NL.
The project started with the group visiting some world experts on flooding; heading to deltawerken the company who run the dams in NL, here the participants learned about the freak weather that caused extensive flooding in 1953 across the country and how the dams have been designed to prevent this, and visiting Deltares to find out more about emergency flood management on a global scale.

The team also got access to the ESA's Climate Change Initiative Toolbox, this allowed them to use ESA's achived Earth observation data to find key climate variables.

Now the team are in full swing, pooling their resources to compile a project that will really make a difference. They have chosen to focus on cities as 80% of the world's population live in urban areas and this figure is increasing, as such a solution for cities will be a solution for most people in the world.

The project will focus on combining space and ground data to warn people about imminent risks as soon as possible in order to limit the damage done.



WORKSHOPS

7 sessions of elective workshops were held across all three of the SSP18 host institutions; Leiden University, TU Delft and ESA-ESTEC. Over 30 visiting experts instructed across 52 activities.

SSP18's elective workshops were a necessary contribution to the overall quality of the program. Some participants used the elective workshops to expand their knowledge of their chosen departmental discipline, while others use them to explore new fields of space studies or to gain a better understanding of the topic of their team project.

Moacir Fonseca Becker (Costa Rica)

Living the SSP is like incarnating a character in the most memorable space tale one can imagine. In this story, one meets the actors leading humankind's course into space. One talks to academically and professionally heroic individuals; one meets inspiring life mentors and astronauts; but, most importantly, one meets and becomes part of a brilliant international space family. SSP is the accumulation of a myriad of very unique and exquisite memories; without a doubt, it's one of the best chapters in one's life. Maybe, the program doesn't really end; maybe it's just the thrilling opening of a greater unimaginable story. Who knows what the future holds?

Zoi Elisabeth Lendway (Austria)

ISU to me is really a community of interdisciplinary, yet like minded professionals that goes beyond this universe. The team project on Lunar Night Survival made me realize once again how precious our universe is, and what an impact ISU students might actually have beyond this academic program; we successfully completed a Moon Analogue Mission at the European Astronaut Center in Cologne! One of my highlights in this program were also definitely the activities of the Engineering Department: Not only did we plan, construct and launch our own team rocket, we also remotely controlled a Mars Rover located in Canada, had our very own Mission Control Academy Training, built and tested a Cubesat and a lander and conducted a Concurrent Engineering

Thomas Wijnen (The Netherlands)

The SSP is to me on a personal level what the discovery of gravitational waves was to science: it has provided me with a new sense of the universe. Thanks to the program and everybody involved I have gained many new insights and valuable experiences. I feel privileged to be able to work, interact, laugh and have fun with so many different, inspiring people from all around the world.

PROFESSIONAL VISITS

Space Applications visit to ISIS

Professional visit to Innovative Solutions in Space (ISIS) headquarters, which is one of the Netherland's leading companies in the small satellite market, including Cubesat and Nanosat solutions. Established in 2006, ISIS combines research and development, testing, launch services, ground stations, and operation of small space systems.

Learn about why small satellites are important game changers in the field of space and gain insight into how a small, entrepreneurial and vertically integrated smallsat company is structured.

During the morning the department traveled to Utrecht to visit SRON which is the Netherlands Institute for Space Research and provided introduction about the company, gave us a technological development example and a tour to see some technical highlights. They closed the program with a presentation that spans the process from early idea till successful launch and scientific harvesting. Participants learned about their contributions to Earth sciences, astrophysical research, and planetary research. Afterwards, the group traveled to the north part of the country to ASTRON which is the institute for radio astronomy and learned about the company's scientific instrumentations which are under development as well as those that have been successfully launched

Combined visit to the European Astronaut Center

Three Departments, Engineering, Humanities and Policy-Economics-Law had the opportunity to visit the ESA's European Astronaut Center and the neighboring German Aerospace Center (DLR) facility in Cologne, Germany.

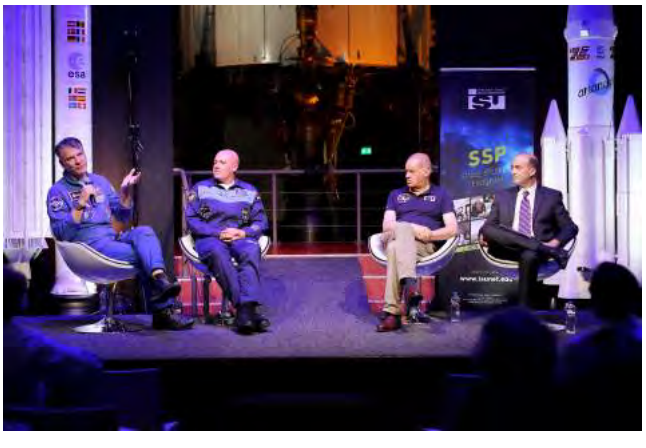
At this facility, the European astronauts work and train. Participants visited the neutral buoyancy facility and learn about how astronauts are trained physically, mentally, and operationally. Furthermore, they examined the opportunities for research innovation in space life sciences and astronaut health.

PUBLIC EVENTS & OUTREACH – SIZZLING SUMMER OF SPACE

This year's SSP featured a wide variety of evening events from distinguished space lecturers from around the world. These events were held at TU Delft, the Leiden University and also at ESA-ESTEC / Space Expo in Noordwijk. This was a great way to enhance creativity, local participation and public engagement.

The Opening Ceremony

This year's SSP18 opening ceremony was a cause for a very big celebration as 2018 kicked off for the first time in the Netherlands with the honorable presence of the King himself, his majesty King Willehm-Alexander. The participants carried the flags of their countries at the ERASMUS building of the ESA Estec facility in Noordwijk, highlighting the international and intercultural aspect of this program.



Annual International Astronaut Panel

Four astronauts took to part in this year's ISU SSP Astronaut panel discussion at Space-Expo, Noordwijk in the Netherlands. Andre Kuipers, Paolo Nespoli, Nicole Stott and ISU alumni Soyeon Yi recalled their personal spaceflight experiences. As one of the most popular events at this year's SSP, more than 500 guests were in attendance.

SpaceUp Netherlands

The dutch public and SSP participants were excited to attend SpaceUp NL Unconference during this year's Space Studies Program. A vast mix of dynamic and inspirational topics were shared. SpaceUp NL took place at TU, Delft where over 100 space enthusiasts got connected thru versatile topics of Space.

ISU Robotics Competition

Six SSP18 teams designed, engineered and built autonomous LEGO® robots simulating remote planetary exploration. A highlight of this event was that the SSP18 participants had to compete with local school robotics groups. Lead by Professor Kazuya Yoshida from Tohoku University in Japan and ISU, the participants competed in the robotics obstacle yard collecting stones that represented interesting geological formations and carrying them back to the basecamp. This represented a "sample return mission" and provided the participants with extra points.

PUBLIC EVENTS & OUTREACH – SIZZLING SUMMER OF SPACE

Annual Rocket Competition

Closing Ceremony

The 2018 Space Studies Program of the International Space University officially ended during the Closing Ceremony that took place in Leiden on Saturday, August 26.

SOCIAL ACTIVITIES

Culture Nights & Talent Night

Every Friday night, participants from the 35 represented countries shared their culture in a very entertaining and sometimes eccentric way! Interactive highlights included Chinese Hot Pot & Dumplings and the traditional SSP presentation of Canada's canoe. The evenings continued on with our very own SSP17 live bands, both participant and staff and dancing late into the night!

Alumni Weekend Gala Dinner and Space Masquerade Ball

Thanks to our generous sponsors, the extended ISU community enjoyed an energetic evening of reunions.

This year's SSP Space Masquerade Ball was masked in mystery as the participants donned their most creative space costumes! Held in conjunction with the ISU alumni conference, participants had a bit of healthy competition from the seasoned SSP alumni who were dressed to impress.

Alumni vs Participants Football Game

This years' Alumni vs Participants Football Game took a high stand in the favour of the participants

Andre Fonseca Prince
Participant from Italy

" The SSP-18 experience was outstanding! Before I left my home to come to the program it was difficult to imagine how great and unique it would be. But once I immersed myself in this amazing world of Space knowledge exchange I realized that my life was about to change forever. I met remarkable people from different nationalities and backgrounds that made my horizons to be expanded. I had the chance to have lectures with the top experts in each of the SSP disciplines. I had an incredible time with the Sciences Department understanding scientific instruments and the secrets of our Universe. And finally, I had an awesome journey during the Team Project weeks. I am so grateful to ISU for providing me this opportunity! "

Ram Salagame Nagabhushana
Participant from India

"SSP-18 is with 3-i, (interdisciplinary, intercultural, international) concept is very unique. As a participant from ISRO, India, its a wonderful experience to meet such intellectuals from different parts of the world. The programme with different aspects covering in three major modules is thrilling. The first part of core lectures, gives insight about the different fields of space technology. The departmental activities and workshops is structured to give more intensive details in one selection field, for me it's a wonderful activity which I enjoyed along with learnings. The last part is Team Project where in the process development is given more importance which is a culmination many interdisciplinary. Surely, it's memorable journey for me to take back."

SOCIAL MEDIA

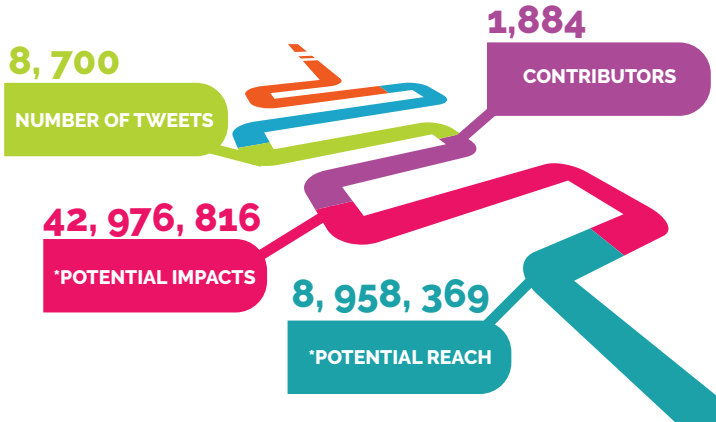
Similar to previous SSP editions, ISU ran a large scale social media campaign, in association with our hosts at TU Delft, Leiden University and the European Space Agency.

This year the campaign utilized mainly Instagram and Twitter in a large scale, and Facebook, LinkedIn, the SSP18 blog and Youtube on the latter. In addition to social media, we were also featured extensively in local and international press. Both traditional and digital media.

We measured the results of our campaign on Twitter, using the Tweetbinder tool, tracking the three official campaign hashtags #SSP18, #NLargeYourUniverse, and #NLSpace, plus mentions of the @ISU_SSP account.

This provides the following results:

@ISU_SSP
#SSP18
#NLargeyourUniverse



*Potential impacts - The potential number of times someone could have seen the hashtag

*Potential reach - Number of unique users that could have seen the hashtag

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Ilan Ramon Foundation
Indian Space Research Organisation (ISRO)
Israel Space Agency (ISA)
National Aeronautics and Space Administration (NASA)
Stichting Space Professionals Foundation (SSPF)
UK Space Agency (UKSA)

Host Institute

The Space Studies Program (SSP) is hosted by the Netherlands Space Office (NSO), in collaboration with three leading Dutch space organizations: the Delft University of Technology (TU Delft), Leiden University and ESA's European Space Research and Technology Centre (ESA-ESTEC).

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