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Annual Report

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Cover Page

Puzzle composed of six images (from the upper left to the lower right):

1. Abstract artwork showing a map depicting all the celestial objects that were detected in the XMM-Newton slew survey between August 2001 and December 2014 (ESA/XMM-Newton/ R. Saxton / A.M. Read).

2. South Korea's island-studded Mokpo port captured by ESA's Earth-observing Proba-V minisatellite (ESA/Belspo).

3. Blue 'ball of string' records 2114 movements made by ESA's XMM-Newton space telescope as it shifted its gaze from one X-ray object to another between August 2001 and December 2014 (ESA/XMM-Newton/A. Read/R. Saxton).

4. The color-coded topographic view shows relative heights and depths of terrain in the Hellas Basin region on Mars (ESA/DLR/FU Berlin).

5. Image of the planetary nebula NGC 6818 taken by the NASA/ESA Hubble Space Telescope (ESA/Hubble, NASA, J. Schmidt).

6. Image combining HRSC images from ESA Mars Express with MOLA topography data from NASA's Mars Global Surveyor (ESA/DLR/FU Berlin & NASA MGS MOLA Science Team).

Table of Contents

The International Space Science Institute (ISSI) is an Institute of Advanced Studies where scientists from all over the world meet in a multi- and interdisciplinary setting to reach out for new scientific horizons. The main function is to contribute to the achievement of a deeper understanding of the results from different space missions, ground based observations and laboratory experiments, and adding value to those results through multidisciplinary research. The program of ISSI covers a widespread spectrum of disciplines from the physics of the solar system and planetary sciences to astrophysics and cosmology, and from Earth sciences to astrobiology.

From the Chairman of the Board of Trustees

During this past year, ISSI has again demonstrated its outstanding scientific activities and visibility through a record number of events and visitors. Its worldwide reputation is the direct result of the generous dedication and commitment of its directorate and staff.

During the two meetings of the Board of Trustees (BoT) corresponding to this 22nd ISSI business year, from 1 July 2016 to 30 June 2017, a few essential decisions were taken, related to two of the directorships.

In November 2016, the BoT unanimously extended the contract of Anny Cazenave (Earth Science Director) for a second term of four years, from July 2017 until June 2021. At the same meeting, I informed the BoT that John Zarnecki (Astrophysics Director) did not wish, for personal reasons, to have his contract renewed after June 2017. The BoT sincerely thanks John Zarnecki for his efficient work and creative commitments in the framework of ISSI and wishes to Anny Cazenave a continuing success.

During that same November meeting, the BoT immediately decided to issue an open call for candidates. It also formed a Selection Committee in order to be able to make a proposal for replacement during the June 2017 BoT meeting. The following members of the BoT agreed to serve on the committee: Jean-Pierre Swings (chair), André Maeder, Georges Meylan, and Lev Zelenyi. As ISSI Executive Director, Rafael Rodrigo was an ex-officio member.

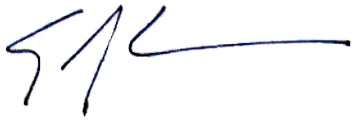
It was decided that the scientific profile of the candidates should be related to extragalactic astrophysics and cosmology, in order to be fully complementary with the other two director's profiles, namely, Earth Observations (Anny Cazenave) and Solar and Stellar Astrophysics (Rudolf von Steiger).

After the February 2017 deadline, ISSI had received 33 valid applications, most of them of very high quality. During a meeting in March 2017, subsequent email exchanges and teleconferences in April 2017, the Selection Committee quickly converged towards a short list of five excellent candidates, who were invited for interviews in Bern in May 2017.

During its June 15, 2017 meeting, the BoT unanimously selected Joachim Wambsganss as next Director for Astrophysics and Cosmology. We welcome him and look forward to his directorship, which will start on October 1, 2017.

Joachim Wambsganss is full Professor at the Department of Physics and Astronomy of the University of Heidelberg and Director of its Zentrum für Astronomie, with outstanding scientific, administrative, and public-outreach skills. His wide research interests range from the search for extrasolar planets with the technique of gravitational microlensing, through the study of quasars to the investigation of the dark matter distribution in galaxy clusters via the analysis of giant gravitational arcs.

It is a great pleasure to thank all ISSI actors, its directorate and its staff, for their excellent work. Many thanks also to all members of the Science Committee, of the Search Committee, and of the BoT for their continuous help and support. ISSI is very grateful to all its funding agencies, national and international. Our constant aim is that ISSI will be able to enlarge the number and the quality of its scientific activities by further increasing the number of its funding agencies and their financial support.



Georges Meylan

Lausanne, August 2017

During the twenty-second year of ISSI, our founding father and Honorary Director Johannes Geiss turned ninety. Sadly, however, he was unable to attend the traditional ISSI Dinner with congratulatory addresses from Rosine Lallement and Len Fisk for health reasons. We wish him all the best and hope for a steady and continued recovery.

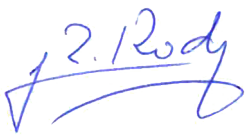
On September 6-8, 2016, ISSI was evaluated again by a Visiting Committee (VC), a process that has now been institutionalized on a three-year basis. This year's committee was chaired by Luke Drury, then chair of the European Space Agency (ESA) Astrophysics Working Group. After an intense three-day session the VC concluded that "[…] ISSI is indeed delivering according to its mandate. As an essentially unique institution it is difficult if not impossible to benchmark the quality of its work against comparable institutions, but the VC considers it to be of a high standard. Finally, and bearing in mind the high fixed costs of operating in Switzerland, the resources are indeed being used efficiently and effectively as far as we can judge." The report also contains a number of recommendations that have been discussed with the Board of Trustees and will be implemented in due course.

Based on the VC report both ESA contributions (from the Directorates of Science and of Earth Observation) were extended, as was the support from the Swiss Confederation via the State Secretariat for Research, Education, and Innovation (SERI), all at the same level as in the previous years. The support from the Swiss National Science Foundation has been terminated at the end of the calendar year 2016, but as of 2017 this funding will come from the Swiss Academy of Sciences (SCNAT) in exactly the same amount approved by the SNF in August 2016.

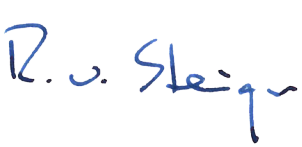
The ISSI Science Committee met for its two regular meetings, reviewing and discussing all future activities. In the Fall meeting, five Workshops were recommended for implementation in 2017/2018 and several more for updated information to be reconsidered at a future meeting. In the Spring meeting, the Committee primarily reviewed 82 Team proposals and recommended 31 for implementation, two of which were joint with ISSI-Beijing.

During the twenty-second year, there were three Workshops held, four Working Group meetings, three Forum meetings, and 70 International Team meetings, all described in more detail in the subsequent pages. Together they brought 939 visitors to ISSI, 401 of which were coming for the first time. The publication record has grown by three volumes in the Space Sciences Series of ISSI and two in the ISSI Report Series. The impact factor of Space Science Reviews (from which the SSSI volumes are reprinted) has increased to 7.50, keeping the journal among the top ten of more than 60 astronomy journals evaluated by Thomson Reuter's Web of Science.

As already reported last year, our longstanding main secretary Jennifer Fankhauser has re-joined ISSI in September 2016 on a part-time basis and is supporting us with her significant experience. Following an open call for two postdoctoral positions, to which we received 77 applications, we were happy to elect Teodolina Lopez and Frederic Effenberger. Teodolina joined us in November 2016 and is supporting the Earth Science part of the ISSI program, while Frederic arrived in May 2017 (after completing his term in Stanford) to support the space science part. Also in May Raphael Marschall joined the ISSI Team as a postdoc to work specifically on the MiARD project. Finally, one of us (JZ) has decided to end his work for ISSI after completing a four-year term. Following an open call for applications, the ISSI Board has elected Joachim Wambsganss from the University of Heidelberg to the ISSI directorate on a part-time basis. We welcome our new colleagues warmly and look forward to a fruitful collaboration.



Rafael Rodrigo

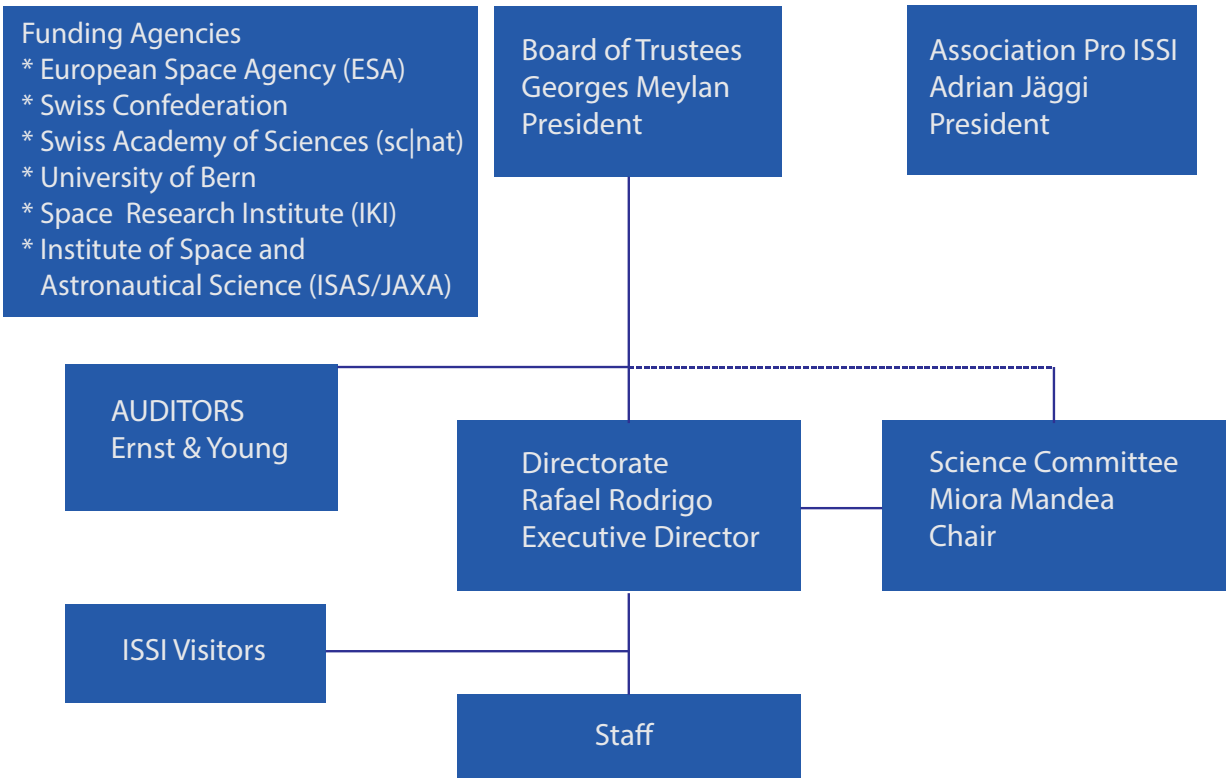


Rudolf von Steiger

Anny Cazenave

John Zarnecki

About the International Space Science Institute



The International Space Science Institute (ISSI) is a nonprofit organization set up in Bern in 1995 as a foundation under Swiss law with an endowment by Contraves Space AG, later renamed Oerlikon Space AG and now part of RUAG. Three statutory bodies govern ISSI: the Board of Trustees, the Directorate, and the Science Committee. A fourth important body, the Association Pro ISSI, promotes the idea of ISSI, especially within Switzerland.

The European Space Agency (ESA), the Swiss Confederation, and the Swiss Academy of Sciences (sc|nat) provide the financial resources for ISSI's operation. The University of Bern contributes through a grant to a Director and in-kind facilities. The Space Research Institute (IKI) and the Institute of Space and Astronautical Science (ISAS/JAXA) are supporting ISSI with an annual financial contribution. ISSI received tax-exempt status from the Canton of Bern in May 1995.

ISSI's **Board of Trustees** oversees the work accomplished at the Institute, exerts financial control, and appoints the Directors and members of the Science Committee. It consists of representatives of the Founder, and of the funding Institutions. Furthermore the Board of Trustees may nominate up to five personalities representing the national and international science community, space industry and space politics for terms of three years. The Board of Trustees is presided over by Georges Meylan.

The **Science Committee**, chaired by Miora Mandea, is made up of internationally known scientists active in the fields covered by ISSI. The Science Committee advises and supports the Directorate in the establishment of the scientific agenda providing a proper equilibrium among the activities and reviews and grades the Team proposals in response to the annual call. Science Committee members serve a three year term (with a possible extension of one year).

The **Directorate** is in charge of the scientific, operational, and administrative management of the Institute. It interacts with the Funding Agencies, the Swiss authorities, the Board of Trustees, the Science Committee and the Association Pro ISSI. The Directorate consists of Rafael Rodrigo (Executive Director), Rudolf von Steiger (University of Bern), Anny Cazenave (CNES, Toulouse, France) and John Zarnecki (The Open University, Milton Keynes, UK).

The **Association Pro ISSI**, founded in spring 1994, counts about 120 members. Pro ISSI promotes the idea of ISSI by organizing public lectures, where internationally known scientists introduce their results. Summaries of these talks are published in the journal SPATIUM. Member benefits include invitations to lectures and a free subscription to SPATIUM. The Board of the Association Pro ISSI is presided over by Adrian Jäggi.

The 22nd financial year of ISSI resulted in a deficit of about 150 kCHF as opposed to a budgeted deficit of 192 kCHF. Luckily, the exchange rate of the Euro to the Swiss Franc has stabilized and even developed somewhat favorably, resulting in a small exchange gain. The deficit is still fully covered by positive results from previous years, specifically from an unexpected payment from the Swiss Confederation for helping to compensate the declining exchange rate of the Euro.

On the revenue side the contributions from ESA (Directorates of Science and of Earth Observation) and from the Swiss Confederation were received as budgeted and are gratefully acknowledged, as is the contribution from our partner ISAS/JAXA. Contributions from the EU H2020 projects, EuroPlanet and HISPAC, are also acknowledged and these programs are now in full operation. Finally, the contribution from the Swiss National Science Foundation has been transferred to the Swiss Academy of Sciences as of January 1, 2017, due to a decision of the federal authorities, where it will continue at the same level. We are very grateful to the SNF for the 20 years it has funded ISSI and look forward to our new partnership with the SCNAT.

In addition to the direct contributions listed here, it is important to note that ISSI also receives indirect contributions that do not appear in the table below: One of the directors is employed directly by the University of Bern, and ISSI also benefits from the University through in-kind contributions such as Internet connectivity etc.

Rudolf von Steiger

Statement of Operations (in CHF) for the 22nd Financial Year (1.7.2016-30.6.2017)

	Expenses	Revenues	
ESA Science Directorate		1'367'520.85	
ESA Earth Observation Programme		325'038.35	
ESA HISPAC		0.00	
Swiss Confederation		960'000.00	
EuroPlanet, MiARD Projects		279'879.00	
ISSI Partners		27'200.00	
Other income or cost [3]		22'957.56	
Salaries and related costs [1]	1'238'036.78		
Fixed costs	282'460.90		
Operating costs [2]	236'827.29		
Investment (depreciated)	28'091.23		
Workshops, Working Groups, Teams, Visitors (ISSI funded) [4]	1'347'348.78		
Result of the Year		150'169.22	
Subtotal	**3'132'764.98**	**3'132'764.98**	*Audited by Ernst & Young, Bern*
Swiss National Science Foundation (SNF) [5]		48'512.15	
Swiss Academy of Sciences (SCNAT) [5]		25'234.30	
Workshops, Working Groups, Teams, Visitors (SNF/SCNAT funded)	73'746.45		
Total	**3'206'511.43**	**3'206'511.43**	*Audited by SNF/SCNAT*

Remarks:

[1] **Salaries:** It should be noted that the majority of the ISSI staff members (including directors) are scientists actively conducting research as well as taking care of organizational, editorial, and administrative tasks.

[2] **Operating costs** include repair and maintenance, insurance, supplies, administration, and public relations.

[3] **Other income** includes extraordinary income, interest income, and exchange gain or loss.

[4] **Workshops, etc.** also include the balance from income and expenses of guest apartments.

[5] **SNF/SCNAT:** Grant from Swiss National Science Foundation resp. Swiss Academy of Sciences to R. von Steiger and related expenses.

The Board of Trustees

front row from left to right:
Rosine Lallement, Observatoire de Paris-Meudon, France, *Vice Chair*
Georges Meylan, Ecole Polytechnique Fédérale de Lausanne, Switzerland, *Chair*
Jean-Pierre Swings, Université de Liège, Belgium
Sergio Volonté, Science and Robotic Exploration Directorate, ESA, Paris, France - retired

Back row from left to right:
Rudolf von Steiger, International Space Science Institute, Bern, Switzerland, *Secretary of the Board*
Adrian Jäggi, President of the Pro ISSI Association, Bern, Switzerland
Lev M. Zelenyi, Space Research Institute (IKI), Russian Academy of Sciences, Moscow, Russia
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Alvaro Giménez, ESA, Paris, France
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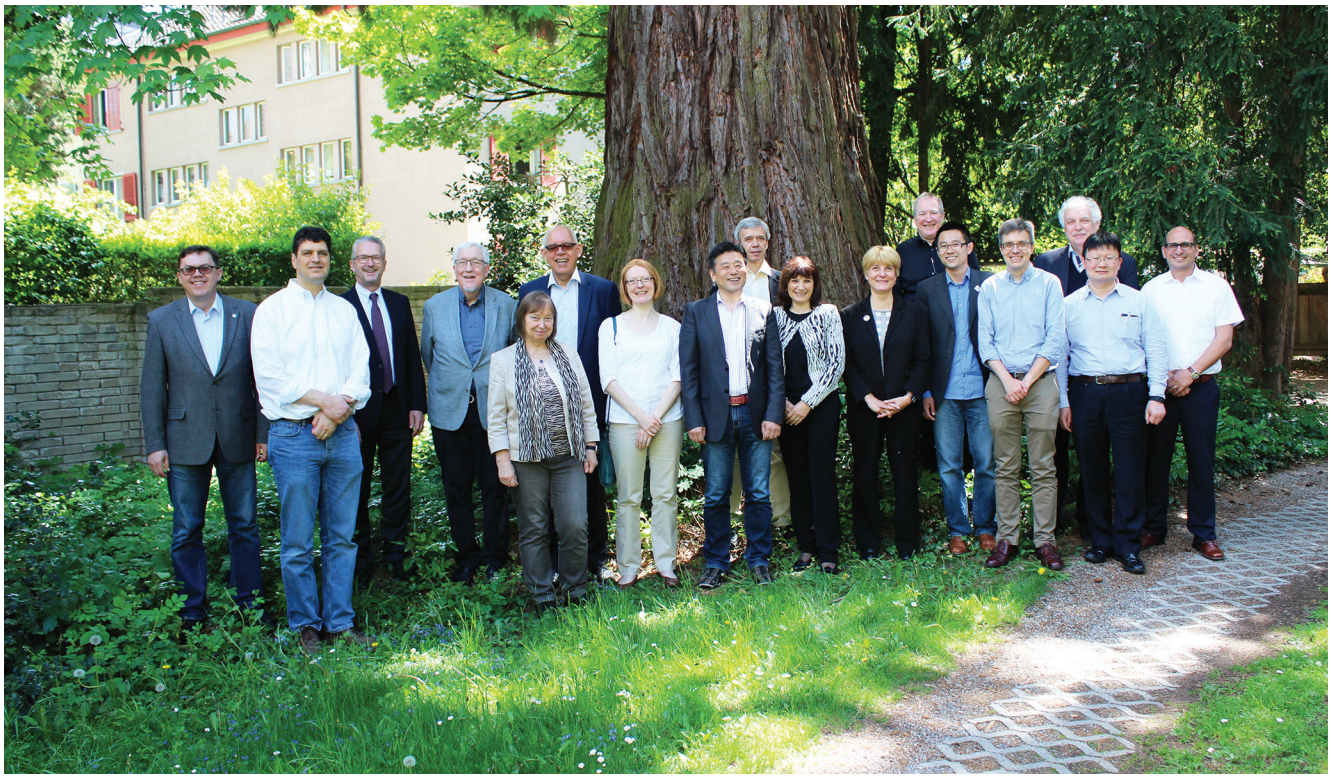
missing from the picture:
Daniel Fürst, RUAG, Zurich, Switzerland
Renato Krpoun, Swiss Space Office, Bern, Switzerland
André Maeder, Observatoire de Genève Sauverny, Switzerland
Ji Wu, National Space Science Center (CAS) and International Space Science Institute Beijing, China

The Science Committee



from left to the right:
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Nathan Schwadron, University of New Hampshire, Durham, USA
Michael Rast, ESA ESRIN, Frascati, Italy (ex officio ESA)
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Kevin Heng, Center for Space and Habitability, University of Bern, Switzerland
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Andrei Bykov, Russian Academy of Sciences, St. Petersburg, Russia*
Xiaolong Dong, International Space Science Institute Beijing, Beijing, China (ex officio)
Maurizio Falanga, International Space Science Institute, Bern, Switzerland, *Secretary of the Science Committee*

missing from the picture:
Daniel Baker, University of Colorado, USA
Corinne Charbonnel, Department of Astronomy, University of Geneva, Switzerland
Luisa M. Lara, Instituto de Astrofisica de Andalucia, CSIC, Granada, Spain*

*Membership ended on 30 June 2017

ISSI Staff

from left to the right:
Anny Cazenave, Director
Teodolina Lopez, Post Doctoral Scientist
Irmela Schweizer, Librarian
Rudolf von Steiger, Director
Alexandra Lehmann, Secretary
Andrei Bykov, Discipline Scientist
Rafael Rodrigo, Executive Director
Vittorio De Falco, PHD Student
Silvia Wenger, Assistant to the Executive Director
Maurizio Falanga, Science Program Manager
Roger-Maurice Bonnet, Senior Discipline Scientist
Saliba F. Saliba, Computer Engineer and System Administrator
John Zarnecki, Director
Andrea Fischer, Editorial Assistant

missing from the picture:
Michel Blanc, Discipline Scientist
Frederic Effenberger, Post Doctoral Scientist
Johannes Geiss, Honorary Director
Jennifer Fankhauser, Part-Time Secretary
Raphael Marschall, Post Doctoral Scientist

All lists show the status at the end of the 22nd business year on 30 June 2017.

The Pro ISSI Association was founded in 1994 under Swiss law with the goals to create a Space Science Institute in Switzerland, and to communicate the fascinating results of space sciences to the Swiss public. With the creation of the Foundation International Space Science Institute (ISSI) in 1995 the first objective had been reached. Pro ISSI focuses now on providing a bridge between leading space scientists and its members, representing universities, industry, politics and public administration. The Association offers public lectures on new insights in space science, and publishes 2-3 SPATIUM issues per year. The Pro ISSI Association, which counts presently 122 members, meets once per year for its general assembly. The Board of Pro ISSI consists of Adrian Jäggi (President), Hansjörg Schlaepfer (Editor Spatium), Frank Rutschmann (Treasurer) and Silvia Wenger (Secretary).

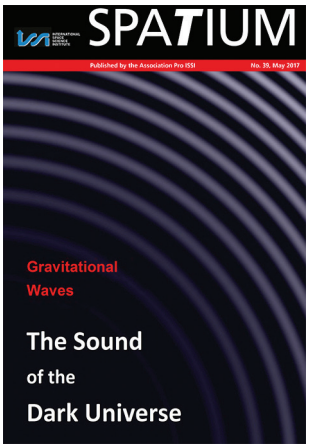
Public Lectures

Pro ISSI organized three public lectures in the period of this report:

The General Assembly was held on 12th October 2016 followed by a lecture by the Director of the Albert-Einstein Institute in Hannover, Germany, Prof. Karsten Danzmann. He spoke about "Gravitational Wave Astronomy: Listening to the Sounds of the Dark Universe!". The presentation elaborated the significance of the first direct detection of gravitational waves and the first observation of a binary black hole merger by the two detectors of the Laser Interferometer Gravitational-Wave Observatory (LIGO).

On 15th March 2017, Prof. Christoph Mordasini from the University of Bern spoke about "Extrasolar Planets: A Laboratory to Confront the Theory of Planet Formation with Observations". The presentation introduced the fundamental concepts of planet formation theory and discussed how extrasolar planets are the ideal testbed to confront theory against the available observations of now more than 3000 extrasolar planets.

On 10th May 2017, Prof. Kurt Lambeck from the Australian National University in Canberra, Australia, and second Johannes Geiss Fellow gave a talk about "Return to Planet Earth: Understanding the Earth from Geodetic Space Observations". The lecture reviewed the history of advances over more than 60 years after the first satellite geodesy results and of their contributions to the understanding of the Earth System.



Covers of the SPATIUM No. 38 and 39 published in the 22nd ISSI Business Year.

SPATIUM

The Association's magazine Spatium elaborates on selected lectures offered by Pro ISSI. It appears twice to three times per year. During the reporting period, issue no. 38 was published in October 2016, reporting on Titan, Saturn's largest satellite. Prof. John Zarnecki from the Open University Milton Keynes, England, and former ISSI director outlined the current knowledge of the only moon in our Solar System with a significant atmosphere. In contrast, issue no. 39, published in May 2017, reports on gravitational waves – the sound of the dark universe. The author, Prof. Karsten Danzmann from the Albert-Einstein Institute in Hannover, Germany, portrayed gravitational waves, their cosmic sources, and the fascinating technologies needed to grasp and decipher the messages from this new view on our universe.

These publications together with all previous issues of SPATIUM can be found on Pro ISSI's homepage www.issibern.ch/publications/spatium.html.

Adrian Jäggi

Scientific Activities: The 22nd Year

The Program and the Tools

ISSI's mode of operation is generally fivefold: multi- and interdisciplinary Workshops, Working Groups, International Teams, Forum, and Visiting Scientists. In the 22nd business year a total of 939 international scientists participated in the scientific activities of ISSI.

Workshops consist of up to 50 invited scientists exchanging their views on a scientific theme, typically during a week's duration. Workshops always lead to a volume of the Space Science Series of ISSI and in parallel as issues of Space Science Reviews or Surveys in Geophysics. In the 22nd year three Workshops were organized, summaries of which can be found on the following pages.

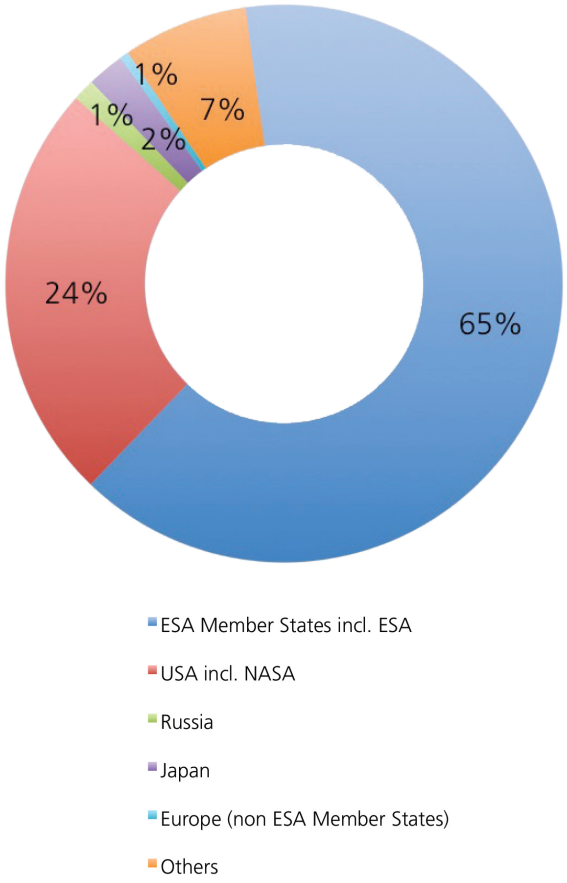
Working Groups have a smaller number of members and meet repeatedly as necessary to achieve the assigned objective. The results of the Working Groups activities are in general published as titles of ISSI Scientific Report Series. In the course of the 22nd business year two new Working Groups started their activities.

International Teams consist of about 15 external scientists, addressing a specific scientific topic in a self-organized fashion. The results of these activities are customarily reported in scientific journals. In total 70 Team meetings took place in the 22nd business year. Details can be found from page 21 on.

A Forum is an informal and free-ranging debate consisting of some 25 high-level participants on open questions of a scientific nature or on science policy matters for about two days. A Forum does not necessarily lead to formal recommendations or decisions. In the reported business year three Forums were held.

Visiting Scientists spend variable periods of scientific activity at ISSI. 14 individual visitors used the ISSI facilities during the year.

The Young Scientists Program is designed to bring PhD students and young post docs in contact with the community at work. These young scientists are invited by ISSI to complement the membership of Workshops, Working Groups, International Teams and Forums. 126 young scientists participated in the ISSI activities in the course of the year.



Pie chart showing the ISSI visitors countries of origin. A total of 939 scientists worked at ISSI during the 22nd business year, 401 of them were here for the first time.

How to use ISSI tools

As a general rule participation in ISSI's activities is by invitation only. The financial support for invited scientists covers the local accommodation expenses and a per diem while in Bern.

International Teams: A call for proposals is released every year in January. These proposals are evaluated by the ISSI Science Committee and approved by the Directorate.

Workshops, Working Groups, and Forums: There is no annual call. The scientific community may suggest at any time Workshops, Working Groups, and Forums by submitting an idea on a maximum of one page. The ISSI Science Committee will evaluate these suggestions and the ISSI Directorate will take a final decision.

Outstanding Questions for Solar System Planetary Science and Associated Key Representative Space Missions, Horizon 2061 (in collaboration with Europlanet)

13–15 September 2016

ISSI is a participant in the 2016-2019 "Europlanet Research Infrastructure" project of the European Commission, which is funded by the Horizon 2020 framework program. As Switzerland was not a full member state for this program at the time of the signature of the contract, ISSI's contribution is actually funded directly and separately by the Swiss Government, for an amount fully consistent with ISSI's expected contributions. ISSI is committed to produce two Forums and three Workshops jointly with Europlanet during the period of the contract, together with the corresponding publication products. In particular, three books of the Space Science Series of ISSI (SSSI) and two publications in the scientific literature summarizing the Forum's main achievements and conclusions are to be published.

During the period covered by the present report, ISSI and Europlanet jointly organized the first Forum and used a specific bottom-up scheme to define the subjects of the three workshops of the contract. The Forum was called: "Outstanding Questions for Solar System Planetary Science and Associated Key Representative Space Missions, Horizon 2061". It gathered 33 international experts in planetary science, together with 10 technology experts representing major space agencies and industry groups heavily involved in planetary exploration missions. This forum was the first step of a 2-year foresight exercise on the future of planetary exploration initiated by the Air and Space Academy (AAE in french), ISSI and Europlanet. Following the first fifty years of initial exploration of the Solar System, the next fifty years, between 2016 and the symbolic date of 2061 corresponding to the return of Comet Halley in the inner Solar System and to the centennial anniversary of the first human space flight, will be largely driven by the key science questions we formulate today about small bodies, planets and planetary systems. This Forum was devoted to identifying with the scientific community the key scientific questions which are going to drive the design of future space missions to the Solar System and to place stringent requirements on the availability of the technologies and infrastructures that will be needed to fly these missions.

The following objectives were assigned to the Forum:

- Identify the outstanding questions concerning our understanding of Solar System objects and of the Solar System as a whole
- Identify related representative ambitious space missions that could potentially address these questions over the coming 50 years
- Address these objectives in the context of the rapidly-expanding science of exoplanets and their systems, which was the subject of the previous 2012 ISSI-Europlanet Forum
- Propose a short list of Workshops held at ISSI addressing some of these outstanding science questions

ISSI–Europlanet Forum Participants

One of the expected outputs was the identification of a list of the most relevant and attractive science themes for the three ISSI-Europlanet Workshops of the Horizon 2020 contract, initially proposed by the Forum participants. The Science Committee was tasked to select and propose to the ISSI Directorate the three scientifically most attractive candidates among these proposals. This process worked very well: the Forum participants proposed over ten excellent ideas for future Workshops. After further review and refinement by the proposers and by the coordinators of Europlanet NA-1 activity, five Workshop proposals were presented to the Science Committee (SC) at its meeting of November 10, 2016. After due evaluation, the SC recommended the three following Workshop themes, in decreasing order of priority, for implementation:

Workshop #1: Role of Sample Return Missions in the Exploration of the Inner Solar System (leader: Mahesh Anand, UK).

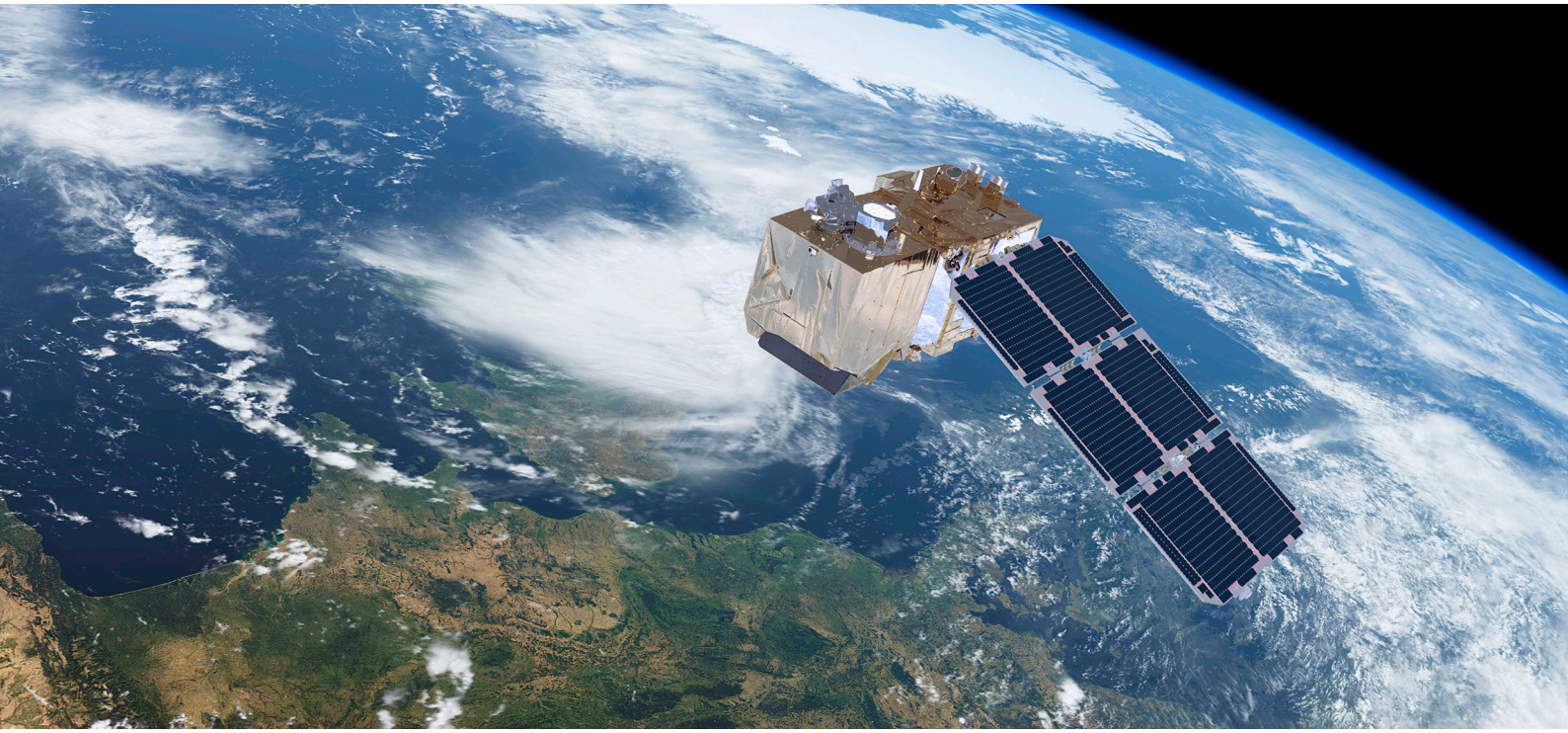
Workshop #2: Comparative study of the atmospheres of planets and exoplanets (leaders: Oleg Korablev, Russia and Karoly Szegö, Hungary).

Workshop #3: Reading terrestrial planet evolution (Venus, Earth, Mars, Titan) in isotopes and noble gases measurements (leader H. Lammer, Austria).

The implementation of the first Workshop started in July 2017 with the first conveners meeting held at ISSI. The Workshop itself will be held in Bern from February 5 to 9, 2018. In parallel, the conveners team that will design the second Workshop has been formed already, so that all the deliverables expected from ISSI for Europlanet's Horizon 2020 contract be made in time.

Michel Blanc

Forums



Sentinel-2 provides information on pollution in lakes and coastal waters. Images of floods, volcanic eruptions and landslides are also offered to help respond to disasters and for humanitarian relief efforts (Image Credit: ESA/ATG medialab).

Forums are informal and free-ranging debates among some twenty-five high-level participants on open questions of a scientific nature or on science policy matters. Forums do not necessarily lead to formal recommendations or decisions.

Monitoring Coastal Zones Evolution Under Various Forcing Factors Using Space-based Observing Systems

11–12 October 2016

The world's coastal zones, where an important fraction of the world population is currently living, are under serious threat because of coastal erosion, cyclones, storms, and salinization of estuaries and coastal aquifers. In the future, these hazards are expected to increase due to the combined effects of sea level rise, climate change, human activities and population increase. The response of coastal environments to natural and anthropogenic forcing factors (including climate change) depends on the characteristics of the forcing agents, as well as on the internal properties of the coastal systems, that remain poorly known and mostly un-surveyed at global scale. To gain information about changes affecting coastal zones, to understand their causes, and provide information to decision-makers and coastal zone managers, various types of observations with global coverage need to be collected and analyzed. In this context, observations from space appear as an important complement to existing in situ observing systems (e.g., regional tide gauge networks). The purpose of the Forum was to investigate whether existing space-based and in-situ observations can help in providing precise and systematic information about coastal zone changes in response to extreme events, natural climate variability, slow processes such as long-term sea level rise, and direct anthropogenic forcing, and highlight the benefit of systematic coastal monitoring from space. A detailed report about this Forum can be found on the following webpage: www.issibern.ch/publications/pdf/forumreports/coastalzones.pdf.

Anny Cazenave

Small Satellites for Space Science (4S)

23–24 May 2017

An international study team of scientist and engineering leaders under the auspices of COSPAR has embarked on a 2-year activity to develop an international scientific roadmap on Small Satellites for Space Science (4S), focusing particularly on CubeSats and CubeSat-technology enabled small satellites. CubeSats are small satellites built in increments of 10 cm cubes (1 cube is called 1U or „unit," two 10 cm cubes together are known as 2U, and so on). The report is motivated by recent progress and results summarized in a published report (Zurbuchen, von Steiger et al, Performing High-Quality Science on CubeSats, Space Research Today, Vol. 196, pp. 10-30, August 2016) and a study by the US National Academies (Zurbuchen, Lal, et al., Achieving Science with CubeSats: Thinking Inside the Box, The National Academies Press, Washington, DC, 2016).

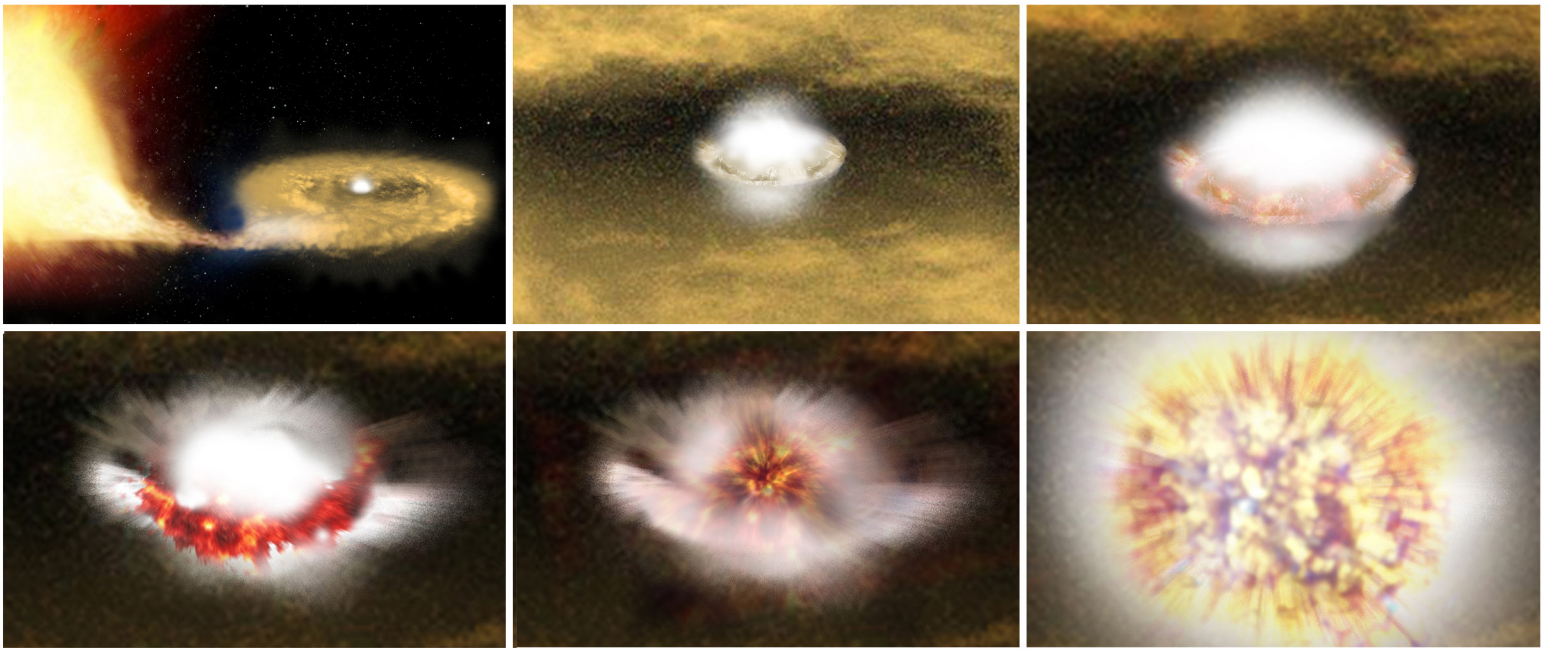
The scientific roadmap will address six specific questions:
1) What are the status and use of CubeSats for science, their technological capabilities, and their key successes to date?
2) What is the scientific potential of small satellites both as stand-alone targeted missions, but also as secondary payloads, and as constellations and swarms?
3) What is the role of participating agencies and industry in developing standardized approaches to the development of spacecraft (hardware and software), and also ground-systems, etc. that enables this science?
4) What are the policies that support the growth of the number and types of CubeSats and CubeSat technology enabled small satellites, related to communications and frequency allocation, orbital debris, and launch vehicles?
5) What are successful models for international collaboration between teams developing and operating small missions, and how are data being shared and preserved for the future?
6) How can participating international universities learn from each other to share lessons learned and drive international collaborations in this rapidly moving field?

These questions should be addressed in a roadmap that is of value to space agencies internationally and their supporting governments. The roadmap is to be developed by a study team that covers a broad range of scientific disciplines, composed of scientists and engineers working in universities, public research institutions and industry. The Team is co-led by Robyn Millan (Dartmouth College, NH, USA) and Rudolf von Steiger (ISSI) and has met in a first Forum meeting on 23–24 May, 2017. An intermediate report of the progress will be given at the 3rd COSPAR Symposium on Jeju Island, Korea, in September, 2017, and a second ISSI Forum is foreseen in the first quarter of 2018. The final Roadmap document should be presented to the 42nd Cospar Assembly in Pasadena in July, 2018.

In June, 2017, a number of prototype "Sprites" – the world's smallest fully functional space probes, built on a single circuit board – achieved Low Earth Orbit, piggy-backing on the 'Max Valier' and 'Venta' satellites. The chips weigh just four grams but contain solar panels, computers, sensors, and radios (Image Credit: www.breakthroughprize.org).

Rudolf von Steiger

Workshops



Artist's impressions of a white dwarf, a star that contains up to 1.4 times the mass of the Sun squeezed into a volume about the same size as the Earth, leeches matter from a companion star (image 1). The Integral measurements suggest that a belt of gas from the companion star builds up around the equator of the white dwarf (image 2). This belt detonates (image 3) and triggers the internal explosion that becomes the supernova (image 4). Material from the explosion expands (image 5) and eventually becomes transparent to gamma rays (image 6). (Image Credit: ESA/ATG medialab)

Supernovae

3–7 October 2016

The Workshop has gathered 42 worldwide leading scientists and was devoted to an in-depth examination of the complex astrophysical events with extreme energy release via multi-wavelength observations and modeling. Supernova explosions at the final stages of the stellar evolution are known to be the major sources of chemical elements, turbulent energy and relativistic particles in galaxies. They are a key element of galactic ecology and evolution both in starburst and normal galaxies. The extreme physical conditions that are present in supernovae are unreachable in terrestrial laboratories and therefore these objects provide unique opportunities to test the physical laws under extreme conditions. Moreover, the study of supernovae has led to new discoveries in fundamental physics as demonstrated by advances made in dark energy cosmology from a thorough analysis of Type 1a supernovae as „standard candles" to measure cosmological distances. The current status of supernovae cosmology was discussed in the Workshop as well as the very impressive progress in the modeling of both core-collapse and thermonuclear supernovae. Furthermore, supernovae are related to the brightest cosmological transients -gamma-ray bursts - and to the origin of magnetars, objects with the highest magnetic fields ever recorded and a subject of previous astrophysical ISSI Workshops. Special attention has been given to the physics of unusual supernovae including superluminous, faint, and fast evolving supernovae. Future multi-messenger studies in the entire band from radio to gamma-rays, combined with the fast growing neutrino and gravitational wave facilities, have been discussed in the Workshop and will be presented in the forthcoming Space Science Reviews volume and in the Space Sciences Series of ISSI books by Springer.

Andrei Bykov

Workshops are selected by the Directorate in consultation with the Science Committee. Proposals or suggestions for Workshops may originate from the external community. The program and speakers are defined by a group of experts serving as conveners. The Workshops can be attended by up to 50 invited scientists. Workshops always lead to a volume of the Space Sciences Series of ISSI (SSSI) published by Springer and in parallel as issues of Space Science Reviews or Surveys in Geophysics.

Cosmic Dust from the Lab to the Stars

31 October – 4 November 2016

Dust is ubiquitous – it is found from the Earth's atmosphere to the edges of our Universe. It is studied in many ways including in-situ measurement, remote observation (in our Solar System through to distant galaxies) and by analysis of returned samples. Progress in the last decade has been significant with sample return missions, in-situ measurements and ground- and space-based measurements, as well as progress in laboratory experiments and modeling. The possible significance of dust in the astrobiological context has also been realized.

In view of the above considerations, it had been therefore felt that the time was appropriate for this Workshop. It was attended by 49 scientists from around 15 countries as well as by ISSI staff. Of the attendees, 6 were Young Scientists. The Workshop was structured around 4 broad themes, namely (i) Interstellar Dust, (ii) Circumstellar Disks, (iii) Dust in the Solar System and (iv) Astrobiology. Each broad theme was further sub-divided into additional more focused topics. A total of nearly 50 presentations were made within this structure including ones from the participating Young Scientists.

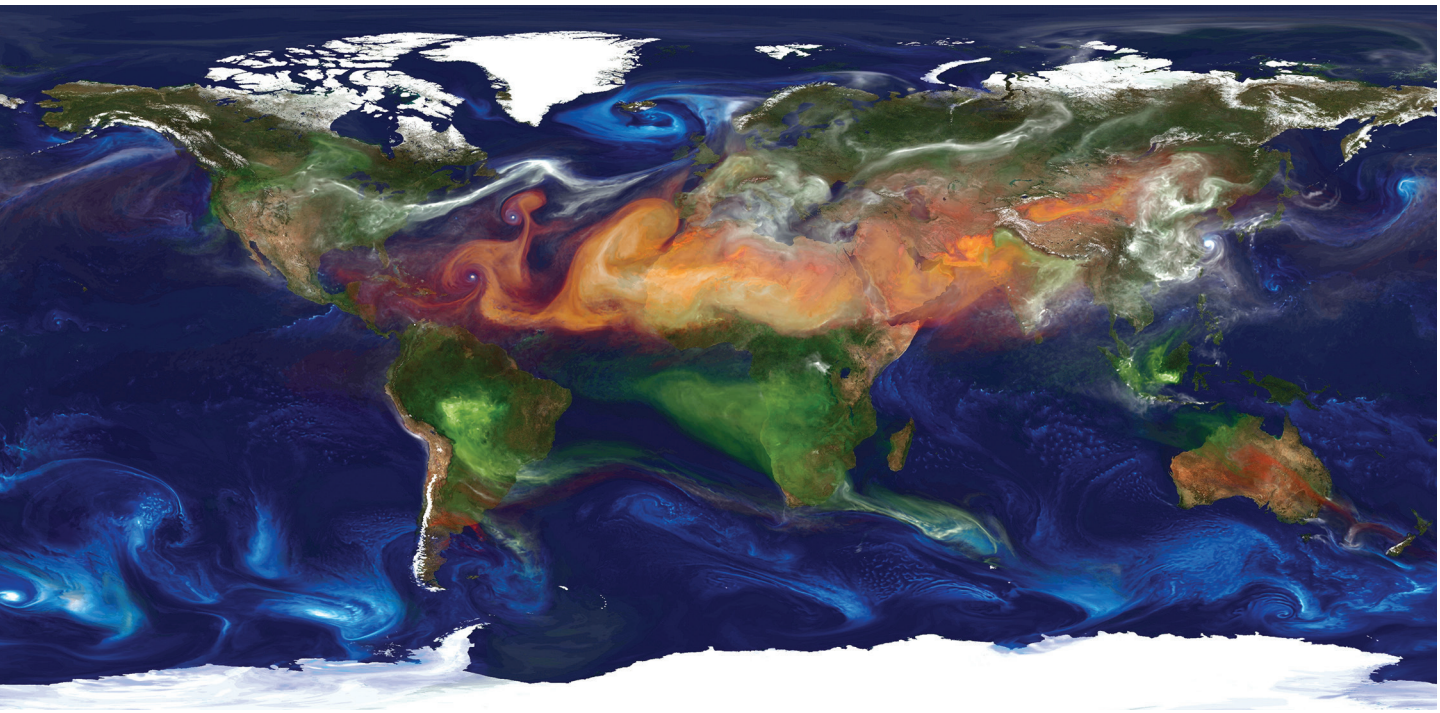
One of the challenges in the study of dust has been to harmonize the different techniques used in the study of dust and the various environments in which dust is found. Participants were encouraged to bear this in mind in making their contributions and in discussions and also to take into consideration that the diverse communities involved have produced a wealth of data but also a wealth of associated interpretations. A further novel aspect compared with most previous dust meetings was that astrobiological connections were considered, as well as the dust hazard, and future technology and space mission requirements and scenarios.

It is now more than 15 years since the last major book publication in the field (Interplanetary Dust, Grün et al., 2001). The time gap and the pace of development merits the next such initiative – now with an emphasis where possible on interconnections, similarities, differences and on synthesizing results from different techniques into one coherent view. It is to be hoped that the ISSI publication arising out of this Workshop will be a compendium with such a coherent view on dust from the different disciplines involved in cosmic dust science and recommendations for future dust research and space missions.

Rafael Rodrigo and John Zarnecki

Picture right showing a cosmic trio makes up just a portion of a vast complex of gas and dust within which new stars are springing to life and illuminating their surroundings. (Image Credit: ESO)

Workshops



Imaging spectroscopy is a key tool for Earth Ecosystems Observation Sciences. It permits to understand and monitor environmental evolution through time. For example, at Earth scale, global aerosols variation is a good illustration of environmental changes as illustrated on this map obtained from GEOS-5 simulation at a 10-km resolution. Dust (red) is lifted from the surface, sea salt (blue) swirls inside cyclones, smoke (green) rises from fires, and sulphate particles (white) stream from volcanoes and fossil fuel emissions (Image Credit: William Putman, NASA/Goddard).

Exploring the Earth's Ecosystems on a Global Scale: Requirements, Capabilities and Directions in Spaceborne Imaging Spectroscopy

21–25 November 2016

In the past decades imaging spectroscopy has proven to provide accurate, quantitative information on the state and evolution of terrestrial and aquatic ecosystems to monitor environmental change and support a sustainable management of land and water resources. The Workshop aim was to bring together leading scientists in the world working in this field together with international scientists involved in the scientific preparation of several future hyperspectral satellite missions as well as experts from different disciplines such as hydrology, soil sciences and ecology.

The Workshop was organized along a selection of environmental themes and issues. The topics covered during this event included a broad panel of different disciplines as climate change impacts, land cover changes and surface processes, biodiversity and ecosystem processes, hazards, and natural resources. This was followed by discussions on data processing and instrumental observations as well as recent radiative transfer modeling progress. All these different aspects showed a wide overview of the state of the art of spectroscopy and how imaging spectroscopy can be used in a synergistic & integrative way – including upscaling, modeling and other observational approaches – for Earth Ecosystems Observation Science.

Nearly 40 scientists, representatives of each discipline considered, attended this Workshop and agreed on a book outline summarizing all the workshop results and recommendations planned to be published in early 2018. The workshop was convened by S. Förster, L. Guanter, J. Moreno, A. Müller, M. Rast, M. Schaepman and N. Champollion.

Teodolina Lopez and Nicolas Champollion

Working Groups are set up by the ISSI Directorate for specific tasks, often also of a technical nature. The results of the Working Groups activities are published as volumes of ISSI Scientific Report Series (SR) or in the scientific literature.

Passive Microwave Virtual Mission Concept

Passive microwave imagery has become a well-established tool to estimate sea ice parameters, e.g. sea ice thicknesses, sea ice concentrations, or snow coverage. Instruments and missions such as the Special Sensor Microwave Imager (SSMI/I), the Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E), ESA's Soil Moisture and Ocean Salinity (SMOS) Earth Explorer mission and NASA's Soil Moisture Active Passive (SMAP) system are able to provide highly complementary brightness temperature measurements across the spectral domain from 1.4 GHz to 89 GHz. The aim of the Working Group is to facilitate the consistent analysis of a broad range of existing passive microwave measurements across missions through common tools and reference data. The objectives are:

- Provide an overview of the existing radiative transfer models linking measured brightness temperatures from the various sensors and geophysical parameters
- Define a strategy towards a community sea-ice emission model that can facilitate an improved and consistent exploitation of existing capabilities
- Outline a model verification strategy including laboratory measurements and campaigns

It was decided to make use of existing capabilities and to use the SMRT (Snow Microwave Radiative Transfer) model – originally developed under an ESA contract for snow packs on land surfaces - as a suitable starting point. Two additional layers representing sea ice and ocean will be added in SMRT. The first set of parameterizations used to describe these layers shall allow the validation of the software and shall enable the community to perform sensitivity studies under varying sea ice parameters. The frequency range shall eventually comprise 0.5 GHz to 100 GHz.

An opportunity for collecting the necessary measurements for model validation is the MOSAIC campaign organized by the Alfred Wegener Institute, which will take place from 1 October 2019 to 31 October 2020. A campaign element supporting radiative transfer model developments, validation, and subsequent parameter retrievals could comprise the operation of one or more radiometers on board RV 'Polarstern' complementing

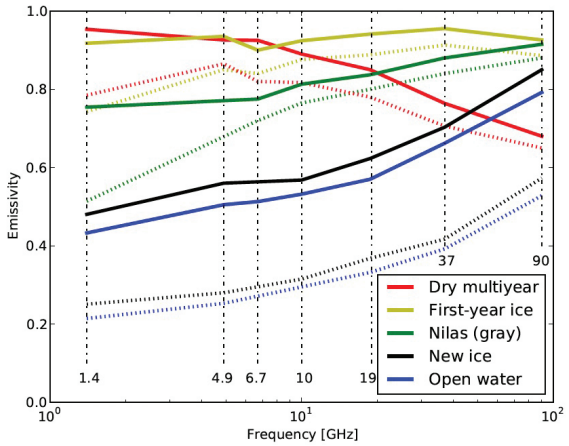


Figure showing Sea ice emissivity at = 50 degrees from model simulations at 1.4 GHz and from radiometric measurements for the other frequencies (Eppler et al., 2013). The vertical and horizontal polarization is displayed by the solid and dotted line, respectively. For the model simulations we assumed dice = 1 cm and Tice = - 2C for new ice, 7 cm and -4 C for gray nilas, 1 m and -7 C for first year ice, and 3 m and -10 C for multi-year ice. (Image Credit: L. Kaleschke, UHH)

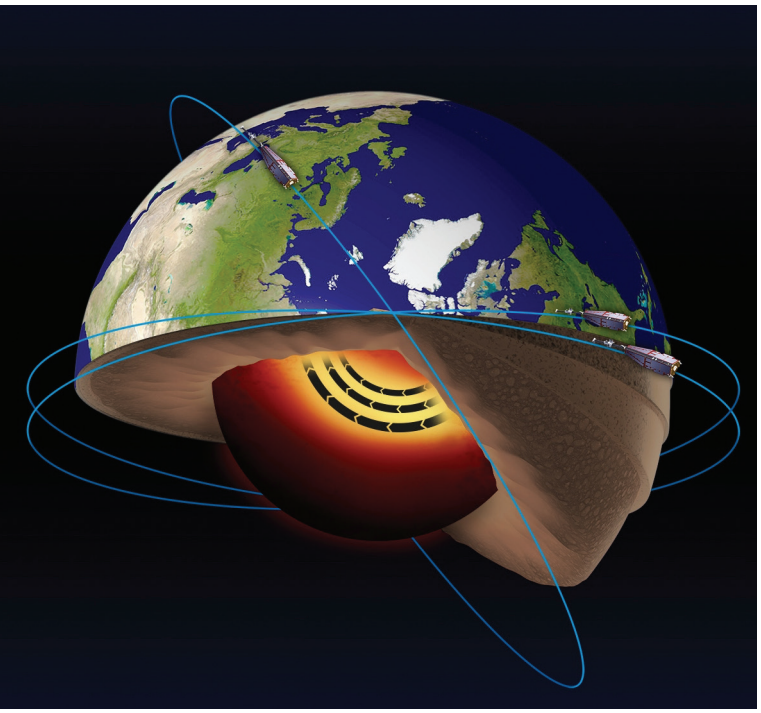
collocated in-situ measurements of sea ice properties. Key objectives would be to measure the brightness temperature at multiple frequencies for snow covered ice across a long period of time under varying environmental conditions. SMRT model validation will include snow and ice microstructures using collocated measurements from remote sensing and in-situ. The corresponding campaign implementation plan is being prepared and suitable radiometer concepts are being studied.

Two meetings (29-30 September 2016 and 22-23 May 2017) were held at ISSI, a third meeting is planned. Members of the Working Group are Nina Maaß (UHH), Lars Kaleschke (UHH), Melody Sandells (CORES), Rasmus Tonboe (DMI), Giovanni Macelloni (IFAC), Julienne Stroeve (UCL), Nander Wever (WSL), Carolina Gabarro (CSIC), Mike Schwank (GAMMA), Christian Mätzler (GAMMA), Steffen Tietsche (ECMWF), Ghislain Picard (University of Grenoble), Marion Leduc-Leballeur (University of Grenoble), Nicolas Champollion (University of Grenoble), Laurent Bertino (NERSC), Ludovic Brucker (NASA), Susanne Mecklenburg and Matthias Drusch (ESA).

Susanne Mecklenburg and Matthias Drusch

Working Groups

Designing a Low-Inclined Nanosatellite Mission to Improve the Science Return of the ESA Swarm Constellation



ESA's Swarm satellites have led to the discovery of a jet stream in the liquid iron part of Earth's core 3000 km beneath the surface. In addition, Swarm satellite data show that this jet stream is speeding up. Launched in 2013, the Swarm trio is dedicated to identifying and measuring precisely the different magnetic signals that make up Earth's magnetic field. (Image Credit: ESA)

The purpose of this Working Group is to organize and run an end-to-end simulation to investigate and optimize the usefulness of adding a low-inclined nanosatellite to the on-going ESA Swarm constellation, for investigations of geomagnetic phenomena and sources.

Indeed, Swarm satellites can detect many more significant geomagnetic signals than can currently be modeled. This is mainly because the current Swarm constellation only involves polar orbiting satellites, with a pair of satellites next to each other experiencing near-identical local times, and a third satellite on a slightly higher orbit, slowly shifting in local time with respect to the lower pair. As a result, sampling during one day of acquisition is done for only four different local times and full local time coverage of all geographic locations currently requires three months. This prevents signals with temporal scales less than three months and longitudinal geographical scales less than the separation between the Swarm orbits to be simultaneously captured by the Swarm constellation. This drawback could partly be corrected for with the help of a fourth satellite, launched at a similar altitude, but on an orbit inclined at typically 60°. Such a "Delta" satellite would be able to sample all local times at all geographic locations between 60°S and 60°N in about one month. In addition, all local times would also be sampled within roughly 90 minutes along transverse orbits that would cross the polar orbits of the Swarm constellation, thus providing the possibility to at least partly characterize the spatiotemporal nature of the signals detected by the Swarm satellites at mid and low latitudes with variability within that time range.

The Working Group has already met once in April 2017 to kick of the work and design a geophysically sound end-to-end simulation setup. Sub-groups have been identified who are in charge of generating the synthetic data needed for the simulation (work under way). The data will be shared with all Working Group members to next start running the end-to-end simulations (i.e., to test the ability of the Swarm + Swarm Delta orbit constellation to recover the signals that will have been injected in the synthetic data). A second Working Group meeting is already planned to take place in spring 2018, to share and discuss the results obtained by then and to identify possible additional simulation configurations. A final meeting will be held in fall 2018 to consolidate results and plan their publication in a book of the Scientific Report Series by Springer Verlag (to be published in 2019). The goal is to put together a reference document that could next be used by ESA, CNES and other space agencies for assessing the improvement that a low-inclined nanosatellite would bring to the on-going ESA Swarm mission. It is also anticipated that as a further outcome of this study, a number of scientific contributions could be published separately in the scientific literature.

Members of the Working Group are (in alphabetical order): Patrick Alken (CIRES, Univ. of Boulder & NOAA NCEI, USA), Elvira Astafyeva (IPGP, France), Arnaud Chulliat (CIRES, Univ. of Boulder & NOAA NCEI, USA), Pierdavide Coïsson (IPGP, France), Chris Finlay (DTU, Denmark), Rune Floberghagen (ESA-ESRIN, Italy), Alexander Grayver (ETH Zürich, Switzerland), Roger Haagmans (ESA-ESTEC, The Netherlands), Gauthier Hulot (IPGP, France), Stavros Kotsiaros (GSFC, USA), Alexey Kuvshinov (ETH Zürich, Switzerland), Vincent Lesur (IPGP, France), Mioara Mandea (CNES, France), Astrid Maute (UCAR, USA), Nils Olsen (DTU, Denmark), Giuseppe Ottavianelli (ESA-ESRIN, Italy), Boris Prokhorov (GFZ Postdam, Germany), Lutz Rastaetter (GSFC, USA), Pierre Vigneron (IPGP, France), and Erwan Thébault (LPGN, France).

Gauthier Hulot

International Teams consist of about 4-15 external scientists, addressing a specific scientific topic in a self-organized fashion, under the responsibility of a Leader in a series of two to three one week meetings over a period of 18 to 24 months. The results of these activities are customarily reported in scientific journals. The selection of Teams results from an annual call for International Teams issued in January and from the subsequent review and prioritization done by the Science Committee.

Listed are Teams that had a meeting at ISSI in the period of the 22nd business year. A rationale is given only for the selected teams in 2016; for the others see the previous Annual Reports.

Teams selected in 2013

Massive Star Clusters Across the Hubble Time
Team leader: Corinne Charbonnel, University of Geneva, Switzerland
Session: 5–9 December 2016

Teams selected in 2014

SZ Clusters in the Planck Era
Team leaders: Nabila Aghanim and Marian Douspis, IAS, Université Paris Sud, France
Session: 22–26 August 2016

Implications for Coronal Heating and Magnetic Fields from Coronal Rain Observations and Modelling
Team leader: Patrick Antolin, National Astronomical Observatory of Japan, Tokyo, Japan
Session: 11–15 July 2016

The Exo-Cartography Inverse Problem
Team leader: Nicolas Cowan, McGill Space Institute, Montreal, Canada
Session: 11–15 July 2016

Small Scale Structure and Transport During Magnetopause Magnetic Reconnection: from Cluster to MMS (ISSI–ISSI Beijing Team)
Team leader: Malcolm Dunlop, Rutherford Appleton Laboratory, Oxfordshire, United Kingdom
Editorial Session: 21–23 June 2017

Analysis of the Circumnuclear Gas and Dust Coma of Comet 67P, the Rosetta Target, on the Basis of 3D and 3D+t Model Fits to Data Collected from Part of the Orbiter Payload
Team leader: Marco Fulle, Osservatorio Astronomico di Trieste, INAF, Italy
Session: 26–30 June 2017

Asteroids and Self Gravitating Bodies as Granular Systems
Team leader: Daniel Hestroffer, Observatoire de Paris, France
Sessions: 14–17 November 2016 and 13–16 March 2017

Improving the Reliability of Solar Eruption Predictions to Facilitate the Determination of Targets-of-Opportunity for Instruments With a Limited Field-of-View
Team leaders: Paul Higgins, University of Dublin, Ireland, and Manolis Georgoulis, Academy of Athens, Greece
Session: 24–28 October 2016

Contemporary Regional and Global Sea Level Rise: Assessment of Satellite and In-situ Observations and Climate Models
Team leader: Benoit Meyssignac, Laboratoire d'Etudes en Géophysique et Océanographie Spatiale (LEGOS), Toulouse, France
Session: 31 May – 2 June 2017

There it Spins: the Hunt for Black Hole Spins
Team leaders: Sara Elisa Motta, European Space Astronomy Centre (ESAC), Madrid, Spain, and Tomaso Belloni, INAF - Osservatorio Astronomico di Brera, Italy
Session: 6–9 February 2017

The Disk-magnetosphere Interaction Around Transitional Millisecond Pulsars
Team leader: Alessandro Papitto, Institut de INAF Osservatorio Astronomico di Roma, Italy
Session: 23–26 January 2017

A Three-Dimensional Ground-to-Space Understanding of Sudden Stratospheric Warmings through a Combination of Numerical Models, Satellite and Ground-Based Observations
Team leader: Nicholas Pedatella, University Corporation for Atmospheric Research, Boulder, USA
Session: 10–14 October 2016

The Effect of Dense Environments on Gas in Galaxies over 10 Billion Years of Cosmic Time
Team leader: Gregory Rudnick, University of Kansas, USA
Session: 17–21 October 2016

International Teams

Solar Heliospheric Lyman Alpha Profile Effects (SHAPE)
Team leader: Martin Snow, University of Colorado at Boulder, USA
Session: 19–22 September 2016

Extension and Improvement of the Mean Sea Level Estimation in the Arctic Regions Using Space Altimetry Data
Team leaders: Pierre Thibaut, Oceanography Division, Ramonville Saint Agne, France, and Eero Rinne, Finnish Meteorological Institute, Helsinki, Finland
Session: 3–5 May 2017

Magnetic Helicity Estimations in Models and Observations of the Solar Magnetic Field
Team leaders: Gherardo Valori, INAF – Osservatorio Astronomico di Roma, Italy, and Etienne Pariat, Observatoire de Paris-Meudon, France
Session: 20–23 September 2016

Teams selected in 2015

Rotational Phenomena in the Saturnian Magnetosphere
Team leaders: David J. Andrews, Swedish Institute of Space Physics, Uppsala, Sweden, and Georg Fischer, Austrian Academy of Sciences, Graz, Austria
Session: 20–24 March 2017

Researching the Diversity of Planetary Systems
Team leader: Juan Cabrera, Deutsches Zentrum für Luft- und Raumfahrt, Berlin, Germany
Session: 6–10 February 2017

Towards New Models of Solar Spectral Irradiance based on 3D MHD Simulations
Team leader: Serena Criscuoli, National Solar Observatory, Boulder, USA
Session: 14–18 November 2016

Plasma - Surface Interactions with Airless Bodies in Space and the Laboratory
Team leaders: Jan Deca and Wang Xu, University of Colorado, Boulder, USA
Session: 19–23 June 2017

Nuclear Reactions in Superdense Matter – From the Laboratory to the Stars
Team leader: Duncan Galloway, Monash University, Victoria, Australia
Session: 30 January – 3 February 2017

Cosmology with Size and Flux Magnification
Team leaders: Alan Heavens, Imperial College London, United Kingdom, and Hendrik Hildebrandt, Bonn Universität, Germany
Session: 19–23 September 2016

Ring Current Modeling: Uncommon Assumptions and Common Misconceptions
Team leaders: Raluca Ilie, University of Michigan, Ann Arbor, USA, and Natalia Ganushkina, Finnish Meteorological Institute, Helsinki, Finland
Session: 20–24 March 2017

EO Validation Across Scales
Team leaders: Alexander Loew, University of Munich, Germany, and Christian Klepp, University of Hamburg, Germany
Session: 10–14 October 2016

Accelerated Ions – The Elusive Component of Solar Flares
Team leader: Alexander MacKinnon, University of Glasgow, United Kingdom
Session: 24–28 October 2016

A Comprehensive View of Stellar Winds in Massive X-ray Binaries
Team leader: Silvia Martínez-Núñez, University of Alicante, Spain
Session: 20–24 February 2017

Particle Acceleration in Solar Flares and Terrestrial Substorms
Team leader: Mitsuo Oka, University of California, Berkeley, USA
Session: 14–17 November 2016

Decoding the Pre-Eruptive Magnetic Configurations of Coronal Mass Ejections
Team leaders: Spiros Patsourakos, University of Ioannina, Greece, and Angelos Vourlidas, The Johns Hopkins University, USA
Session: 8–11 May 2017

Polar Stratospheric Cloud initiative (PSCi) Workshops
Team leader: Michael Pitts, NASA Langley Research Center, Hampton, USA
Session: 24–28 October 2016

Jets Downstream of Collisionless Shocks
Team leaders: Ferdinand Plaschke, Austrian Academy of Sciences, Graz, Austria, and Heli Hietala, Imperial College London, United Kingdom
Session: 1–5 May 2017

Galactic Cosmic Ray Origin and Composition
Team leader: Nikos Prantzos, Institut d'Astrophysique de Paris, France
Session: 10–13 April 2017

The Formation and Evolution of the Galactic Halo – Setting the Scene for the Large Modern Surveys
Team leader: Donatella Romano, INAF-Osservatorio Astronomico di Bologna, Italy
Session: 22–24 May 2017

Radiation Interactions at Planetary Bodies
Team leader: Nathan Schwadron, University of New Hampshire, USA
Session: 12–16 June 2017

Physical Properties of Cometary Nuclei Assessed from the Development of 67P CG's Activity
Team leader: Yuri Skorov, Technical University of Braunschweig, Germany
Session: 9–13 January 2016

Multi-Scale Variations in Auroral Electron Precipitation
Team leader: Daniel Whiter, University of Southampton, United Kingdom
Session: 29 August – 2 September 2016

Comparison and Validation of Global Non-Potential Magnetic Models of the Solar Corona
Team leader: Anthony Yeates, Durham University, United Kingdom
Session: 9–13 January 2017

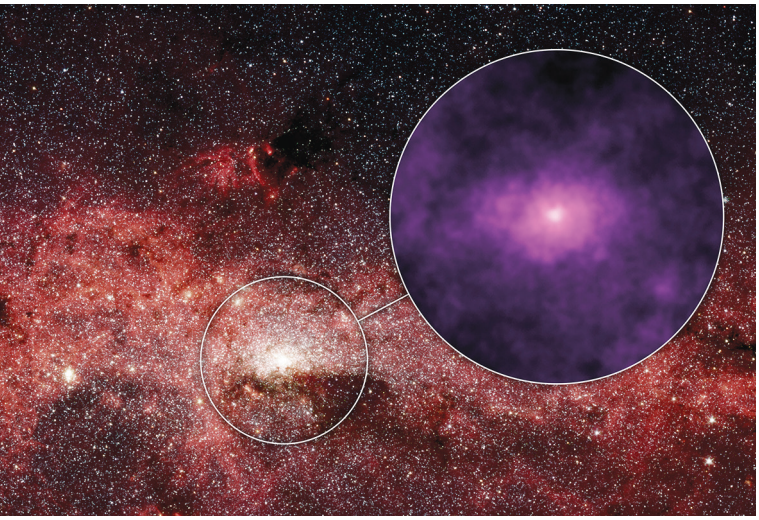
Solar UV Bursts – A New Insight to Magnetic Reconnection
Team leader: Peter Young, George Mason University, Fairfax, USA
Session: 6–10 March 2017

Teams selected in 2016

From Qualitative to Quantitative: Exploring the Early Solar System by Connecting Comet Composition and Protoplanetary Disk Models
Team leader: Boncho Bonev, American University, Washington, USA
Session: 5–9 December 2016
Scientific Rationale: A synergistic collaboration between protoplanetary disk modelers and comet scientists aims to establish a stronger connection between their respective fields. The Team summarizes relevant studies of parent volatiles observed in comets. Since observed volatile abundances are likely byproducts of both formative conditions and post-formative evolution, the Team outlines those measurements most suitable for a meaningful comparison with disk models. The scientists also discuss the advancements in modeling the chemical evolution of protoplanetary disks following molecular cloud core collapse. Comet data will then be interpreted in the context of the best disk modeling networks (chemical and physical).

Quasi-periodic Pulsations in Stellar Flares: A Tool for Studying the Solar-Stellar Connection
Team leader: Anne-Marie Broomhall, University of Warwick, United Kingdom
Session: 27 February – 3 March 2017
Scientific Rationale: Flares that are far more energetic than typical solar flares have been observed on solar-like stars, leading to predictions that the average occurrence rate of these so-called "superflares" on "stars with similar rotation periods to the Sun is about once in 500 to 600 years". However, given that these flares are far more energetic than typical solar flares, and that the data upon which these predictions are made consist of unresolved white light observations of the star in question's brightness, it is reasonable to ask whether these predictions are justified. The current reliance on technology makes us ever more susceptible to the impact of extreme space weather, associated with energetic events such as flares. Studying stellar flares is vital for understanding the mechanisms responsible for magnetic fields in stars, and the physical processes responsible for flares and space weather on our own Sun. To truly understand the link between stellar superflares and solar flares one must first create a solid link between the physical processes occurring in each case. The aim of this Team is to create such a link through quasi-periodic pulsations.

International Teams



NASA's Nuclear Spectroscopic Telescope Array, or NuSTAR, has captured a new high-energy X-ray view (magenta, Figure 1) of the bustling center of our Milky Way galaxy. The smaller circle shows the area where the NuSTAR image was taken -- the very center of our galaxy, where a giant black hole resides. That region is enlarged to the right, in the larger circle, to show the NuSTAR data. (Image Credit: NASA/JPL-Caltech)

Investigating the Magnetosphere through Magnetoseismology

Team leader: Peter Chi, UCLA/IGPP, Los Angeles, USA
Session: 6–10 March 2017
Scientific Rationale: Magnetoseismology is a unique and well demonstrated method to investigate the structure and dynamics of the magnetosphere. Normal-mode magnetoseismology makes use of the widespread field line resonance in the magnetosphere and has successfully shown the variability of the plasmasphere in timescales ranging from within an hour to over a solar cycle. Travel-time magnetoseismology analyzes impulse propagation and has enabled new capability of remotely monitoring sudden impulses and substorm onsets, which are important magnetospheric phenomena that are rarely measured on site. The two methods of magnetoseismology bear substantial resemblance to the techniques used in terrestrial seismology and helioseismology which have advanced our understanding about the interior of the Earth and the Sun. The Team represents an international collaboration on magnetoseismic research at an unprecedented scale, and its major goals are to establish a unifying framework for estimating plasma mass density from field line resonance observations as well as to fill the knowledge gap in using travel-time magnetoseismology to remotely detect substorm initiation and other impulsive events in the magnetotail.

A Tropical Width Diagnostics Intercomparison Project

Team leader: Sean Davis, NOAA ESRL Chemical Science Division, Boulder, USA
Session: 13–17 March 2017
Scientific Rationale: Many important features of Earth's large-scale atmospheric circulation are connected to the width of the "tropical belt", including the locations of the subtropical dry zones and the mid-latitude jet streams. These phenomena exert a strong influence on regional surface climates in both hemispheres, and even small changes in their position may have important societal and ecological consequences. It is therefore crucial to understand whether there have been changes in the width of the tropical belt over the recent past, and, if so, what factors have contributed to these changes.
These outstanding issues motivated a recent American Geophysical Union Chapman Conference on "The Width of the Tropics: Climate Variations and Their Impacts" in 2015 [Davis et al., 2016]. A key recommendation from the meeting is that the interrelationships between the diverse array of tropical width metrics used in the literature need to be better understood in order to explain the discrepancy among past tropical widening estimates and to provide clarity regarding future projections. This Team is fulfilling this goal by conducting the first systematic intercomparison of tropical width diagnostics.

Ultraluminous X-ray Sources: From the Local Group to the Very First Galaxies

Team leaders: Tassos Fragos (former leader) and Andreas Zezas, University of Crete, Greece
Session: 27 February – 3 March 2017
Scientific Rationale: The Team combines all the necessary expertise in order to address the following key points:
1) Compile a comprehensive sample of ultraluminous X-ray sources (ULXs) in the local Universe for which we will derive the properties (star-formation history and metallicity) of host galaxies parent stellar population. 2) Develop population models where the crucial ULX phase will be modeled through detailed simulations, avoiding the simplifications of traditional modeling tools, and constrain them to the local observed ULX sample. 3) Construct a library of physically self-consistent X-ray spectral models that will be incorporated in the population models in order to accurately predict the spectral energy distributions of ULX populations. 4) Use these synthetic models to estimate the properties of ULXs in the early Universe, constrain the models to current deep X-ray surveys, and make predictions about what future X-ray missions, like Athena, will observe. 5) Reexamine the role of ULXs as a feedback mechanism that can regulate both the thermal evolution of the early Universe and star-formation in the local Universe.

Observation-Driven Modeling of Solar Phenomena

Team leader: Klaus Galsgaard, University of Copenhagen, Denmark
Session: 16–19 January 2017
Scientific Rationale: For a theoretical model to accurately represent the physical evolution of the solar atmosphere, the model must, minimally, be consistent with observations of the modeled system. Accordingly, a starting point for modeling such systems is to directly incorporate information obtained from solar observations. In this project, the Team attacks open problems in the process of running such "observation-driven" simulations. In particular, the Team members shall investigate the development of small-scale magnetic structures, such as Bright Points. The goal is to go from observations, through MHD modeling, to forward modeling, with the aim of eventually providing synthetic observations that can be directly compared with the original observations. To do this, the Team evaluates each step in this chain, to find an optimal approach to performing each task, allowing for the most accurate overall solution possible.

Towards a New Generation of Massive Star Models: Improving Stellar Evolution Modelling with Hydrodynamics Simulations and Observations

Team leader: Cyril Georgy, University of Geneva, Switzerland
Session: 30 January – 3 February 2017
Scientific Rationale: Massive stars are the main drivers of the chemical evolution of galaxies. They enrich them with newly synthesized elements ejected in stellar winds or supernova explosions. Due to their extraordinary luminosities, they are visible at extragalactic distances, and thus extremely useful for the study of the distant Universe. The goal is to gather specialists in stellar evolution modeling, hydrodynamics, asteroseismology, and spectroscopy to determine the actual discrepancies between the modeling and observations, and how hydrodynamics can help improve these models. The aim is to discuss how the transport processes should be included in the models in agreement with the results of the hydrodynamics simulations, and to identify the relevant observational tests to verify the stellar models.

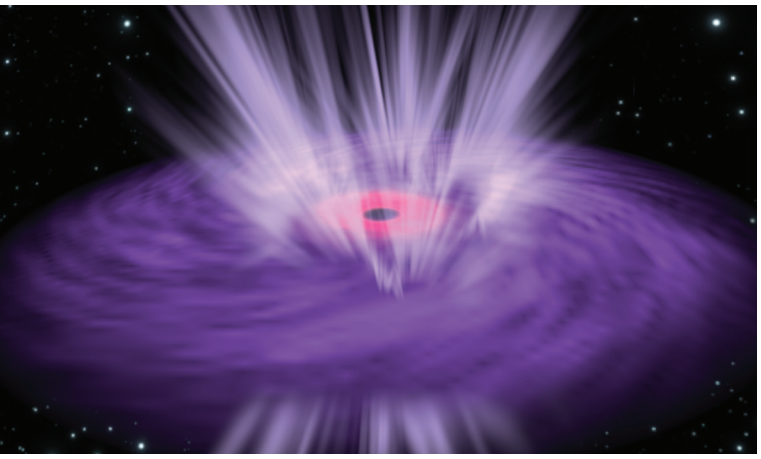
The Physics of the Very Local Interstellar Medium and its Interaction with the Heliosphere

Team leader: Joe Giacalone, University of Arizona, USA
Session: 8–11 May 2017
Scientific Rationale: The interstellar medium is known to be turbulent from several parsecs, to scales smaller than the size of our heliosphere. The heliosphere itself, which is the result of the solar wind's interaction with the interstellar medium, has variations of its own, including solar wind turbulence and massive transient disturbances than can affect the very local interstellar medium (VLISM). The goal is to advance the understanding of the physics of this mutual interaction in the context of a variety of recent observations. These include in-situ measurements of the VLISM by Voyager 1, remote observations of energetic neutral atoms coming from the outside the solar system as seen by NASAs Interstellar Boundary Explorer (IBEX) mission, and the anisotropy of high-energy galactic cosmic rays (GCRs) from Earth-based air shower detectors, revealing structure related to the VLISM. In addition, there have been recent theoretical and modeling studies related to these observations. The Team brings experts together in each of these areas to discuss how they inform us of the nature of the VLISM, and particularly of the nature of interstellar turbulence which affects the transport of high-energy charged particles, such as GCRs.

MMS and Cluster Observations of Magnetic Reconnection

Team leader: Kyoung-Joo Hwang, NASA Goddard Space Flight Center, Greenbelt, USA
Session: 28 November – 2 December 2016
Scientific Rationale: The Cluster mission has emphasized multi-scale processes occurring throughout the Earth's magnetosphere since 2000. The MMS mission, helps unravel the mysteries of magnetic reconnection with unprecedented time-resolution measurements of particles and fields. MMS and Cluster provide us with an opportunity to capture a micro-to-macroscopic picture of plasma processes, which include the structure and extent of reconnection X-lines, reconnection jets and outflow, the generation, structure, and evolution of flux transfer events (FTEs) and dipolarization fronts (DFs), and wave structures, propagation, and evolution. Additionally, in conjunction with the Van Allen Radiation Probes, ARTEMIS, and THEMIS, MMS and Cluster provide measurements of spatial and temporal phenomena in the solar wind, magnetopause, and magnetotail that can affect the radiation belts. The project will make full use of these unprecedented opportunities to compare, resolve, and understand reconnection process, including FTEs and DFs, etc., as a function of solar activity.

International Teams



Artist impression illustrating a supermassive black hole with X-ray emission emanating from its inner region (pink) and ultrafast winds streaming from the surrounding disk (purple). (Image Credit: ESA)

The Early Evolution of the Atmospheres of Earth, Venus, and Mars

Team leader: Colin Johnstone, University of Vienna, Austria
Sessions: 28–30 September 2016 and 29–31 March 2017
Scientific Rationale: The atmospheric and surface conditions of Earth, Venus, and Mars formed as a result of a chain of astrophysical and geophysical/chemical processes. The end results were the formation of a habitable environment on the Earth and highly inhospitable environments on Venus and Mars. Understanding these processes will improve our understanding of the formation of life on Earth and help us achieve a general understanding of how habitable planetary environments form. The Team studies the early evolution of the atmospheres of Earth, Venus, and Mars as test cases for the formation of habitability on terrestrial planets. The Team contains a unique combination of expertise in the evolution of planetary interiors and surfaces, atmospheric formation processes, the Sun's activity evolution, planetary atmospheric loss mechanisms, and atmospheric chemistry.

Using Tidal Disruption Events to Study Super-Massive Black Holes

Team leader: Peter Jonker, Netherlands Institute for Space Research, SRON, Utrecht, the Netherlands
Sessions: 7–11 November 2016 and 19–23 June 2017
Scientific Rationale: For several decades, astronomers have speculated that a hapless star could wander too close to a super massive black hole and be torn apart by tidal forces. It has only been with the recent advent of numerous wide field transient surveys that such events have been detected in the form of giant-amplitude, luminous flares of electromagnetic radiation from the centers of otherwise quiescent galaxies. The Team work is focused on investigating how to: (i) test the different theoretical models for the optical tidal disruption events (TDEs) emission (ii) best use TDEs to determine the astrophysical inputs of interest: e.g. black hole masses and spins (iii) manage the observational follow-up resources in the era when about 1 TDE per day will be discovered (iv) reliably determine the TDE rates which are a proxy for the mass of the black hole seeds that grow into SMBHs.

Strong Gravitational Lensing with Current and Future Space Observations

Team leader: Jean-Paul Kneib, Ecole Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Session: 14–16 February 2017
Scientific Rationale: The Team includes scientists in the field of (strong) lensing. These scientists have already developed the required simulation tools and have made great progress on the lens finding algorithms and modeling techniques to be exploited in this project. The goal is to make all of this work (in particular the simulated data) publicly available to the scientific community. These standard sets of simulated images will enable many investigations by any scientists interested in strong lensing science beyond our expert group of scientists, which will certainly lead to better science results. We also plan to write-up our findings in a set of review papers that will become references on this topic for the coming years.

Towards a Unified Solar Forcing Input to Climate Studies

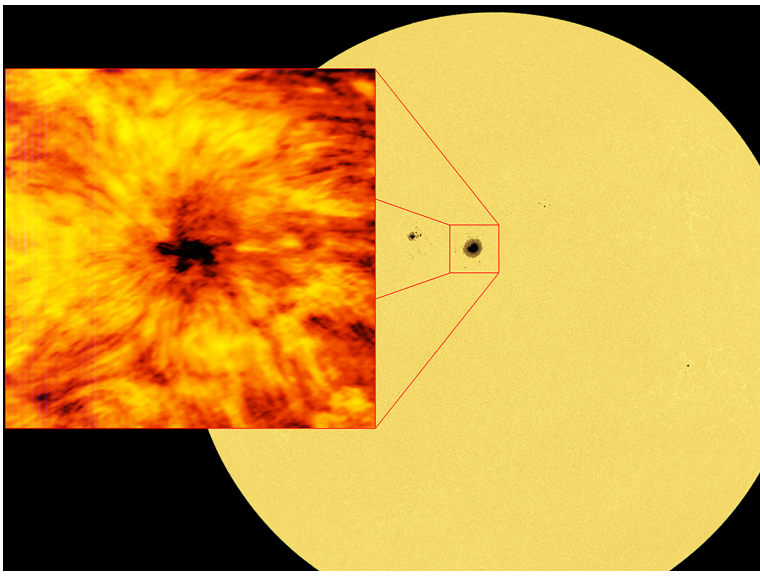
Team leader: Natalie Krivova, Max-Planck-Institut für Sonnensystemforschung, Göttingen, Germany
Session: 20–23 February 2017
Scientific Rationale: Almost four decades of space-based solar irradiance monitoring have enriched us with a great amount of data from numerous experiments at different wavelengths. The utility of the available total and spectral irradiance records for atmospheric and climate research is, however, limited by their inhomogeneous and incomplete wavelength and temporal coverage and often by limited instrument stability. The main goal of this Team, which includes experts in solar irradiance instrumentation, observations, data analysis and modeling, as well as atmospheric and climate scientists, is to fill this gap and reach a consensus on a single and homogeneous modeled irradiance record to recommend to the climate community. This effort will also include realistic estimates of the remaining uncertainties. This Team will play a central role in forming such a consensus, which will be summarized in a review article and later presented to and discussed within the wider community in a separate and larger meeting.

Solving the Prominence Paradox

Team leader: Nicolas Labrosse, University of Glasgow, United Kingdom
Session: 6–10 February 2017
Scientific Rationale: Solar prominences are usually presented as relatively quiet structures where the plasma and the magnetic field do not exhibit significant large-scale changes, unless an eruption takes place. The Team includes 12 experts of all the aspects involved in tackling the following questions: Observations across the EM spectrum (from EUV to mm wavelengths) including spectroscopy, radiative transfer, photospheric dynamics, magnetic field models, and polarimetry. The Team analyses data obtained during previous campaigns (e.g. with THEMIS, the Dutch Open Telescope, Meudon and Ondrejov spectrographs, the Solar Dynamics Observatory, Hinode and IRIS), and during future campaigns including new observations with ALMA (planned as part of a proposal for Cycle 4 observations). Combined with an exploration of recent and new prominence models, the Team will aim to build the most consistent picture to date of these dynamical prominences.

Ionospheric Space Weather Studied by RO and Ground-based GPS TEC Observations

Team leader: Jann-Yenq Liu, National Central University, Taoyuan, Taiwan
Session: 18–21 April 2017
Scientific Rationale: The Team utilizes space-based and ground-based GPS signals to construct models monitoring and forecasting ionospheric space weather for satellite positioning, navigation, and communication as well as studying and exploring related space sciences. FORMOSAT-3/COSMIC (F3/C) constellation launched on 15 April 2006, which consists of six micro-satellites in the low-earth orbit, is capable of uniformly monitoring the global ionosphere by using the powerful technique of radio occultation (RO). The F3/C probes more than 1500 observations per day, and in total, its tropospheric/stratospheric and ionospheric RO soundings accumulate more than 6-million and 4-million profiles during the 10-year mission period, respectively. This provides an excellent opportunity to monitor three-dimensional (3D) structures and dynamics of the electron density and the scintillation in the ionosphere response to diurnal, seasonal, solar activity, and geographic variations. In summary, the Team utilizes space-based RO and ground-based GPS observations to develop advanced ionospheric monitoring, nowcast, and forecast models understanding 3D structure and dynamics, as well as finding new science features in the ionosphere response to space weather.

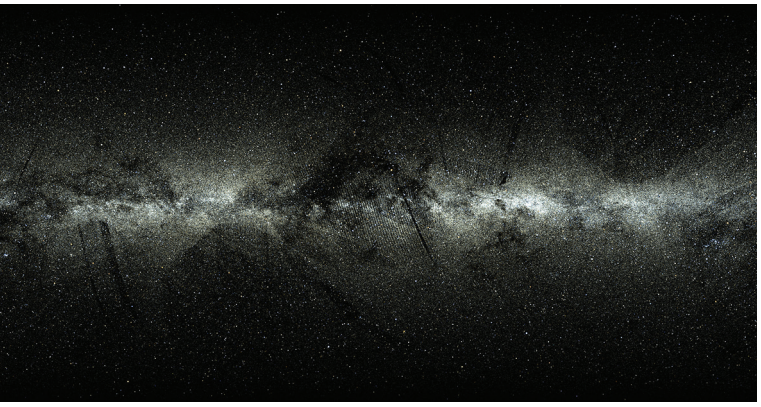


This image of the Sun was taken in the red visible light emitted by iron atoms in the Sun's atmosphere. Light at this wavelength originates from the visible solar surface, the photosphere. A cooler, darker sunspot is clearly visible in the disc, and as a visual comparison is shown alongside the image from ALMA. (Image Credit: ALMA (ESO/NAOJ/NRAO), NASA)

AsteroSTEP - Asteroseismology of STEllar Populations

Team leader: Andrea Miglio, University of Birmingham, United Kingdom
Session: 12–16 December 2016
Scientific Rationale: The interdisciplinary Team develops, tests, and applies methods to characterize the full crono-chemo-dynamical properties of giant stars in the Milky Way's disc. This includes data analysis of spectra and of photometric light curves, the determination of relevant stellar properties using models of stellar evolution, and the comparison of observational constraints with chemo-dynamical models of the Milky Way. The interaction between researchers of complementary expertise (stellar evolution, asteroseismology, spectroscopy, Galaxy formation and evolution) will also foster synergies with the forthcoming Gaia data release, and devise a strategy for future endeavours in the field of galactic archaeology and asteroseismology. This will be key for defining the observing strategies of the NASA TESS and the ESA PLATO missions and their massive spectroscopic follow-up with e.g. 4MOST, WEAVE, and APOGEE2.

International Teams



The positions of two million stars in our Galaxy, based on data from the Tycho-Gaia Astrometric Solution, one of the products of the first Gaia data release. (Image Credit: ESA/Gaia/DPAC)

Understanding the Fate of Binary Systems in the Gaia Era *(ISSI - ISSI Beijing Team)*

Team leader: Nami Mowlavi, University of Geneva, Switzerland
Session: 16–20 January 2017
Scientific Rationale: The majority of stars in the Universe, with a notable exception of M-dwarfs, are in binary or multiple systems. They play a major role in the evolution of stellar populations, and are at the origin of some of the most fascinating objects in modern astrophysics. Key questions need first to be answered in order to achieve these studies. Among them are the identification of eclipsing binary parameters that can be extracted from large scale multi-epoch surveys, including Gaia, their link with observable properties of binary systems, and the efficiency of binary population synthesis models to predict various binary evolutionary channels based on eclipsing binary parameters extracted from large-scale multi-epoch surveys. The purpose of this project is to clarify and answer those questions. The study will rely on space- and ground-based multi-epoch surveys of eclipsing binaries such as Kepler and OGLE, and on simulated Gaia-like eclipsing binary time series in advance of, and in preparation for the study of, real Gaia data of eclipsing binaries.

Studies of the Deep Solar Meridional Flow

Team leaders: Markus Roth, Kiepenheuer-Institut für Sonnenphysik, Freiburg, Germany and Junwei Zhao, Stanford University, USA
Session: 28 November – 2 December 2016
Scientific Rationale: The Team focuses on coordinated studies on validating helioseismic methods, joint analysis of existing data sets, and further development of techniques in order to understand the origin of possible discrepancies between the methods. It is the ultimate goal to provide the best possible estimate of the structure and temporal variability of the Sun's meridional flow and its role in the solar dynamo process. Consequently, the results of this international effort will find direct application in the modeling of the solar dynamo, resulting in a better understanding of the Sun's magnetic activity.

Explosive Processes in the Magnetotail: Reconnection Onset and Associated Plasma Instabilities

Team leader: Mikhail Sitnov, Johns Hopkins University, Laurel, USA
Session: 17–21 October 2016
Scientific Rationale: The mechanism of explosive processes in the terrestrial magnetotail, such as substorms and bursty bulk flows, is one of the most fundamental unsolved problems in magnetospheric physics. The Team concentrates on the following questions: - What are the relative roles of reconnection, buoyancy and flapping in various explosive phenomena in the magnetotail, from substorms to dipolarization fronts? - What are the pre-onset configuration and particle distributions of the magnetotail plasma and fields? - What are the differences and relative roles of driven and spontaneous explosions? - What is the role of the ionosphere in the relevant magnetotail instabilities and how do magnetospheric processes map to the auroral activity?

Main Belt Comets

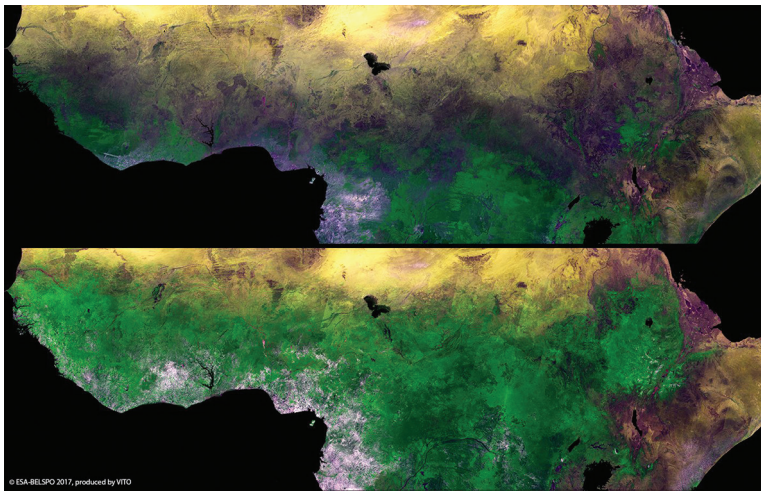
Team leader: Colin Snodgrass, The Open University, Milton Keynes, United Kingdom
Session: 9–13 January 2017
Scientific Rationale: Recent observational results show that water is prevalent throughout our solar system, including in many previously unexpected locations, such as in the main asteroid belt. Water is essential for life as we know it and an important tracer of the formation and evolution processes in our solar system, especially when preserved in minor bodies. The Team brings together experts in comet observation, including those with expertise in dust tails and in detecting water across different wavelength ranges, and modelers who work on understanding active bodies, from thermal models of the survival and sublimation of water ice, to the release and flow of dust grains. The question of how to observe the very weak gas release from MBCs, and therefore conclusively show that they contain water, is one key topic to be addressed.

The Role of Shallow Circulations in Organizing Convection and Cloudiness in the Tropics

Team leader: Bjorn Stevens, Max Planck Institut für Meteorologie, Hamburg, Germany
Session: 27 February – 3 March 2017
Scientific Rationale: The Team focuses on how meso-scale radiative-convective and dynamical processes control clouds and convection within the trades, thereby complementing (and profiting from) earlier work (also by other ISSI Teams) which emphasized aerosol-cloud interactions. The work advances the use of present measurements and of a new generation of satellite remote sensing, particularly in light of the forthcoming ADM-AEOLUS and EarthCare missions. The expected outcomes will be: (i) a review paper on the topic of the Study Project; (ii) a shorter and higher profile perspective article on the importance of lower tropospheric water vapor, clouds and the meso-scale and our present capacity to observed these processes from space; and (iii) the refinement of the experimental plan, and the potential expansion of scope, of what is anticipated to be a major (generational) international field study in the tropical Atlantic sometime in 2019 or in early 2020.

Past, Present, and Future of Active Experiments in Space

Team leader: Anatoly Streltsov, Embry-Riddle Aeronautical University, Daytona Beach, USA
Session: 5–9 December 2016
Scientific Rationale: The Team has two closely connected goals. The first goal is to make a comprehensive review of active experiments conducted during the last decade at different facilities as well as the theoretical concepts used to explain these results. This review will be published in the Space Science Review or Review of Geophysics. The second goal is to develop quantitate, detailed plans and conduct several active experiments which will address the unsolved problems within each of the five major research questions. The main idea here is to develop plans, which will predict the outcome from the experiments based on the parameters of the heater and on the geomagnetic conditions during the experiment. The ultimate goal is to provide a solid understanding of the basic physics of the MI interactions related to the heating of the ionosphere with powerful HF waves. To prove that this goal is achieved the Team members first will make the quantitative predictions of the expected results and then verify these predictions with the experiments.

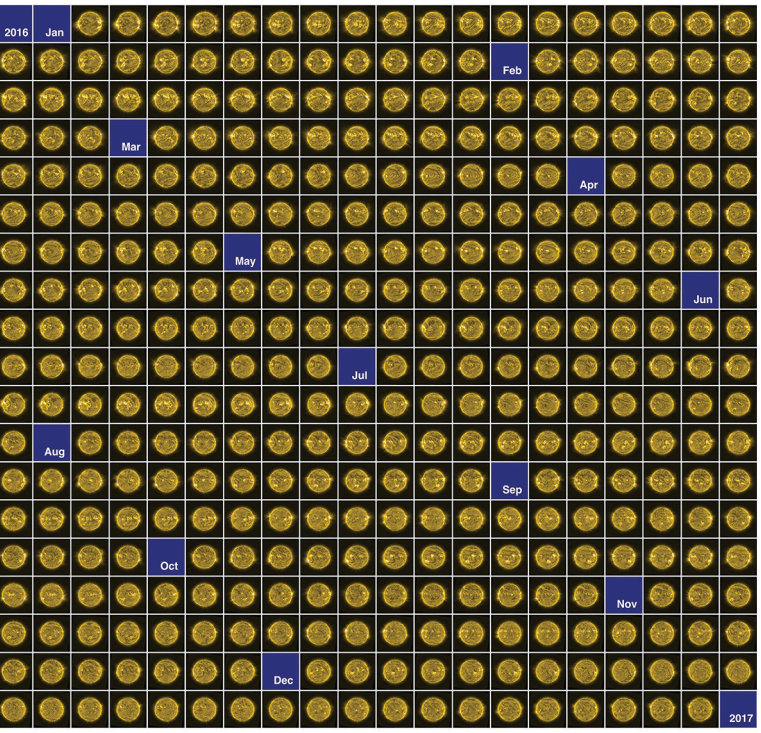


ESA's Proba-V minisatellite reveals the seasonal changes in Africa's sub-Saharan Sahel, with the rainy season allowing vegetation to blossom between February (top) and September (bottom). (Image Credit: ESA/Belspo – produced by VITO)

Stratospheric Sulfur and its Role in Climate (SSiRC)

Team leader: Larry W. Thomason, NASA Langley Research Center, Hampton, USA
Session: 30 January – 2 February 2017
Scientific Rationale: The SSiRC Team focuses on addressing key science challenges regarding the impact of stratospheric sulfur and related aerosol on climate in the 21st century. These challenges include the need to prepare measurement and climate model strategies and develop instrumentation to assess the impact of a future major volcanic eruption on climate and society in a timely manner. SSiRC addresses these challenges following a multi-pronged approach in which the Team will mainly focus on four themes:
- Improving the historical observation-based stratospheric aerosol data set and including an estimate of the total stratospheric sulfur burden.
- Investigating the feedback between stratospheric aerosol and climate by developing tools to improve interactive aerosol representation in climate models and investigating how a changing climate affects non-volcanic stratospheric sulfur sources and their transport.
- Assessing the state of knowledge of aerosol and aerosol precursor transport and microphysical processes in the UT/LS as currently represented in climate models.
- Assessing the current ability to rapidly determine likely climate impacts of a major volcanic eruption including determining what we need to do to be prepared for making crucial observations.

International Teams



This montage of 366 images shows our Sun through the eyes of ESA's Proba-2 satellite, as seen each day in 2016. (Image Credit: ESA/Royal Observatory of Belgium)

Diagnosing Heating Mechanisms in Solar Flares through Spectroscopic Observations of Flare Ribbons *(ISSI - ISSI Beijing Team)*

Team leader: Hui Tian, Peking University, China
Session: 16–20 January 2017
Scientific Rationale: Solar flares are among the most energetic events in the solar system. Flare ribbons are one of their best-observed features that can provide critical diagnostics for the fundamental flare physics not yet well understood. With a high cadence up to a few seconds and a resolution of ~0.33 arcsecond, NASA's Interface Region Imaging Spectrograph (IRIS) mission has revealed unprecedented details of ribbon dynamics in hundreds of flares since July 2013. The Team members propose to understand flare heating mechanisms through joint efforts of spectroscopic observations focusing on flare ribbons and advanced numerical modeling. Modeler Team members perform state-of-the-art radiative-hydrodynamic simulations by experimenting various heating mechanisms to reproduce observations. Supplementary space and ground-based observations is used to provide additional constraints. The Team's work will significantly advance our understanding of flare heating mechanisms and thus prepare us well for future opportunities offered by new space missions such as ESA's upcoming Solar Orbiter.

Exploring the Ultra-Low Surface Brightness Universe

Team leader: David Valls-Gabaud, Observatoire de Paris, France
Session: 16–20 January 2017
Scientific Rationale: The ultra-low surface brightness Universe remains the last niche to be explored in observational parameter space, due to the strong biases that exist in current instrumentation. Yet observing the Universe at levels which are a tiny fraction brighter than the sky background reveals a wealth of astrophysical objects whose properties appear to be entirely different from those at brighter surface brightness levels, from huge extended galaxies to the filaments of the cosmic web, through the revision of the abundance of dwarf galaxies and the role of intra-cluster light. The main aim is to review critically the current space-based observations, in the UV, optical, and IR, and to assess the best strategies for further space observations.

Towards Dynamic Solar Atmospheric Magneto-Seismology with New Generation Instrumentation

Team leaders: Gary Verth, Sheffield University, United Kingdom, and Richard Morton, Northumbria University, United Kingdom
Session: 27–31 March 2017
Scientific Rationale: Solar Atmospheric Magnetoseismology is the study of the Sun's atmosphere by exploiting Magnetohydrodynamic waves to probe the local plasma environment, inverting measured wave properties to obtain difficult to measure plasma parameters. Inspired by geo-seismology and helioseismology, the field started in the late 1980's from theoretical foundations. It was only in the late 1990's that, with the launch of ESA's Solar and Heliospheric Observatory (SOHO) & NASA's Transition Region and Coronal Explorer (TRACE), the first observations of MHD waves in the corona were made. Much progress was made in probing the Sun's corona, although, the observations were few and far between. This was changed with the commissioning of the Coronal Multichannel Polarimeter (CoMP) in 2007 and the launch of JAXA's Hinode mission, which found evidence for ubiquitous MHD waves in the corona and chromosphere. The past decade has led to numerous studies of these waves, however, it has become clear that the theoretical assumptions underlying the magneto seismological inversion techniques are, in general, not satisfied. With access to a wealth of MHD wave observations in the Sun's atmosphere and the promise of improved instrumentation in the near future, it's time to revisit the basics and prepare!

A New View of the Solar-stellar Connection with ALMA

Team leaders: Sven Wedemeyer, University of Oslo, Norway, Tim Bastian, National Radio Astronomy Observatory, Charlottesville, USA, and Hugh Hudson, University of Glasgow, United Kingdom
Session: 3–7 April 2017
Scientific Rationale: The key scientific objective is to advance our understanding of the solar/stellar connection with particular focus on solar/stellar activity and with implications for stars in general, including stellar magnetism and dynamos and the role of host stars for extra-solar planets. The scientists intend to use simultaneous observations with ALMA and space-borne observatories for the Sun and a moderate sample of other stars, which are already available in archives or will be performed. Measurements of mm-radiation-based activity indicators (ALMA) will be compared systematically to "classical" indicators from space-borne telescopes. The interpretation of the observations will be supported by state-of-the-art numerical simulations of the solar atmosphere and corresponding synthetic observables, which can be evaluated in their spatially resolved form for solar observations and (after integrating over a stellar disk) in spatially unresolved form for stellar observations.

The Influence of Io on Jupiter's Magnetosphere

Team leader: Ichiro Yoshikawa, University of Tokyo, Japan
Session: 26–30 September 2016
Scientific Rationale: A large coordinated observing campaign has probed Jupiter's magnetosphere at multiple wavelengths using more than a dozen ground- and space-based facilities, including the EUV spectroscope Hisaki/EXCEED, HST, Chandra, XMM-Newton and IRTF. These observations were focused on the JAXA Hisaki mission which is providing quasi-continuous measurements of emissions from both Jupiter's aurora and the Io plasma torus. The concurrent observations examined Io's volcanic activity and plasma torus variability, as well as Jupiter's auroral dynamics at radio, infrared, ultraviolet and X-ray wavelengths. The Team aims to bring together these observations with state of the art modeling of processes in the inner magnetosphere in order to explore the interactions between Io, Jupiter, the magnetosphere and the surrounding solar wind. Through combined analysis of these diverse measurements, the scientists develop a better understanding of how mass and energy are transferred through the Jovian system on different timescales. The arrival of the NASA Juno mission at Jupiter (2016) as our results will provide global context for interpreting Juno observations.

Rossby Waves in Astrophysics

Team leader: Teimuraz Zaqarashvili, University of Graz, Austria
Session: 20–24 February 2017
Scientific Rationale: The Team has a wide range of expertise in order to summarize current studies of Rossby-type waves in different astrophysical applications and to set up collaboration between the different areas. The expertise of the members combines skills in the theory of Rossby waves, numerical simulations, ground- and space- based observations applied to different astrophysical objects (Sun, solar-like stars, astrophysical discs, exoplanets, neutron stars etc.). The work stimulates the exchange of knowledge in three areas. The Team aims to discuss the effect of large-scale magnetic field on nonlinear behavior of Rossby waves in general and on Rossby soliton solution in particular. The main expected outcome of the proposal is to share knowledge and to establish collaboration between the different communities working on Rossby waves in different astrophysical applications.

Climate Change in the Upper Atmosphere *(ISSI - ISSI Beijing Team)*

Team leader: Shunrong Zhang, MIT Haystack Observatory, Westford, USA
Session: 1–5 May 2017
Scientific Rationale: Climate change is characterized by global surface warming associated with the anthropogenic increase in greenhouse gas concentrations since the start of the industrial era. In the Earth's upper atmosphere where many modern technologies are used, it is now recognized that a long-term cooling has been taking place over the past several solar cycles. Compelling evidence for such cooling comes from direct measurements of the thermospheric density and the ionospheric temperature. However, there are several outstanding issues, for example, (1) the very strong ionospheric cooling observed by multiple ionospheric radars that does not fit with the prevailing theory based on the argument of anthropogenic greenhouse gas increases; (2) CO_2 trends in the mesopause region observed by satellite missions are about twice of what current general circulation models predict; (3) trends in atmospheric wave activity and their impacts on the atmosphere-ionosphere system are poorly known and unquantified. The Team is taking on these challenging outstanding topics as our research theme, with the goal to improve the understanding of the long-term trends in the ionosphere and thermosphere.

International Teams approved in 2017

The following listed teams have been selected for implementation from the proposals received in response to the 2017 Call for International Teams:

SOFAR - Seismology of Fast Rotating Stars
Team leader: Jérôme Ballot (FR)

Electrostatic Manipulation of Nano-Scale Objects of Lunar Regolith
Team leader: Elena Besley (UK)

The Evolution of Rich Stellar Populations & Black Hole Binaries
Team leader: Christian Boily (FR)

The Solar and Stellar Wind Connection: Heating Processes and Angular Momentum Loss
Team leaders: Allan Sacha Brun (FR) and Sean Matt (UK)

Plasma Heating and Particle Acceleration by Collisionless Magnetic Reconnection
Team leaders: Jörg Buechner (DE) and Masahiro Hoshino (JP)

Hydrogen Escape Across the Solar System and Beyond (ISSI – ISSI Beijing Team)
Team leader: Michael Chaffin (US)

Comet 67P/Churyumov-Gerasimenko Surface Composition as a Playground for Radiative Transfer Modeling and Laboratory Measurements
Team leader: Mauro Ciarniello (IT)

Towards a Unified Sea Level Record: Assessing the Performance of Global Mean Sea Level Reconstructions from Satellite Altimetry, Tide Gauges, Paleo-Proxies and Geophysical Models
Team leaders: Sönke Dangendorf (DE) and Marta Marcos (ES)

Studying Magnetic-Field-Regulated Heating in the Solar Chromosphere
Team leaders: Jaime De La Cruz and Jorritt Leenaarts (SE)

High-Energy Particles Sources and Powerful VHF Radiations in Electrically Active Atmosphere: Theoretical Models and Space Borne Instruments
Team leader: Maxim Dolgonosov (RU)

Observed Multi-Scale Variability of Coronal Loops as a Probe of Coronal Heating
Team leaders: Clara Froment (NO) and Patrick Antolin (UK)

Plasma Environment of Comet 67P after Rosetta
Team leader: Marina Galand (UK)

An International Reference for Seismological Data Sets and Internal Structure Models of the Moon (ISSI – ISSI Beijing Team)
Team leaders: Raphael A. Garcia (FR) and Peimin Zhu (CN)

Soft Protons in the Magnetosphere focused by X-ray Telescopes
Team leader: Fabio Gastaldello (IT)

Current Sheets, Turbulence, Structures and Particle Acceleration in the Heliosphere
Team leaders: Antonella Greco (IT) and Olga Khabarova (RU)

Satellite-Derived Estimates of Antarctic Snow- and Ice-Thickness
Team leaders: Petra Heil (AU) and Rachel Tilling (UK)

Globular Clusters in the Gaia Era
Team leaders: Vincent Hénault-Brunet (NL) and Mark Gieles (UK)

Low Frequency Imaging Spectroscopy with LOFAR – New Look at Non-Thermal Processes in the Outer Corona
Team leader: Eduard P. Kontar (UK)

Spacetime Metrology, Clocks and Relativistic Geodesy
Team leaders: Sergei Kopeikin (US) and Jürgen Müller (GER)

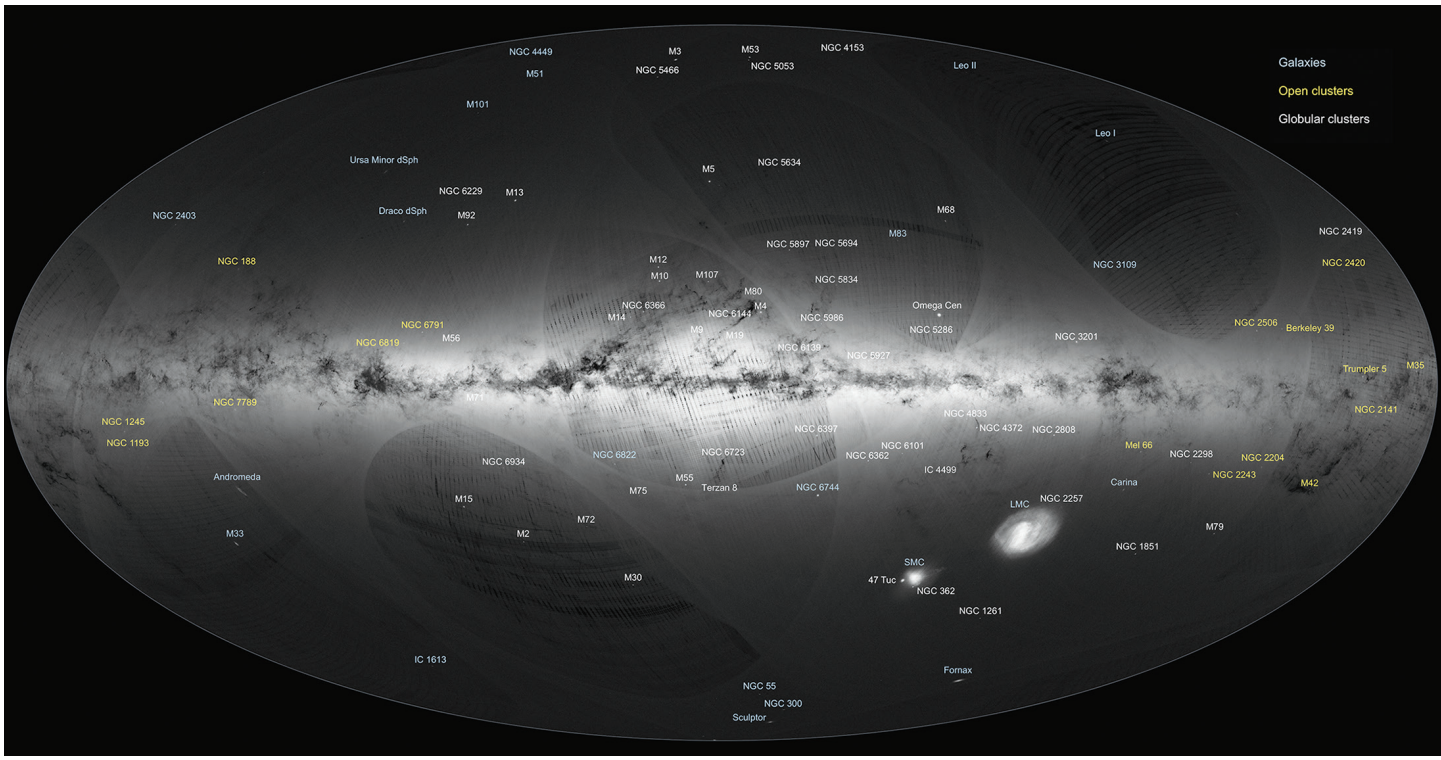
New Features in the Meteor Radar Observations and Applications for Space Research
Team leader: Alexander Kozlovsky (FI)

The ENCELADE Team: Constraining the Dynamical Timescale and Internal Processes of the Saturn and Jupiter Systems from Astrometry
Team leader: Valéry Lainey (FR)

Kappa Distributions: From Observational Evidences via Controversial Predictions to a Consistent Theory of Suprathermal Space Plasmas
Team leaders: Marian Lazar (BE) and Horst Fichtner (DE)

Large-Amplitude Oscillations as a Probe of Quiescent and Erupting Solar Prominences
Team leader: Manuel Luna (ES)

Physics of Dust Impacts: Detection of Cosmic Dust by Spacecraft and its Influence on the Plasma Environment
Team leader: Ingrid Mann (NO)



An all-sky view of stars in our Galaxy – the Milky Way – and neighboring galaxies, based on the first year of observations from ESA's Gaia satellite, from July 2014 to September 2015. This map shows the density of stars observed by Gaia in each portion of the sky. Brighter regions indicate denser concentrations of stars, while darker regions correspond to patches of the sky where fewer stars are observed (Image Credit: ESA/Gaia/DPAC).

Understanding the Origins of Problem Geomagnetic Storms
Team leaders: Nariaki V. Nitta and Tamitha Mulligan (US)

Magnetic Topology Effects on Energy Dissipation in Turbulent Plasma (ISSI - ISSI Beijing Team)
Team leaders: Vyacheslav Olshevsky (BE) and Francesco Valentini (IT)

Recalibration of the Sunspot Number Series
Team leaders: Mathew James Owens (UK) and Frédéric Clette (UK)

Linking the Sun to the Heliosphere using Composition Data and Modelling
Team leader: Susanna Parenti (FR)

Multi-technique Characterization of Near-Earth Space Environment
Team leader: Ashik Paul (IN)

Reconstructing Solar and Heliospheric Magnetic Field Evolution Over the Past Century
Team leader: Alexei A. Pevtsov (US)

Towards Unified Error Reporting (TUNwER)
Team leaders: Thomas von Clarmann (DE) and Douglas A. Degenstein (CA)

Johannes Geiss Fellow 2016 and Visiting Scientists

The Johannes Geiss Fellowship (JGF) is established to attract to ISSI – for limited duration visits – international scientists of stature, who can make demonstrable contributions to the ISSI mission and increase ISSI's stature by their presence and by doing so will honor Johannes Geiss for his founding of ISSI and his contributions to ISSI, and for his many contributions to a broad range of space science disciplines.

Kurt Lambeck, working at the Australian National University, was elected among 21 applicants as the Johannes Geiss Fellow 2016. In the following paragraphs he answers a few questions asked by Teodolina Lopez, ISSI Postdoc in Earth Sciences, about his scientific work.

Teodolina Lopez: During the introduction of your Pro ISSI talk in May 2017, Adrian Jäggi said that you have worked on a broad spectrum of subjects. Could you give us a quick summary?

Kurt Lambeck: What I am interested in, and what I have been researching ever since my first major contribution to satellite geodesy in ~1970, has been the study of the response of the Earth to external and internal forces using the entire breath of geophysical, geodetic and geological tools, supplemented at times by historical and archaeological information. The original idea was to focus on the solid-Earth response function, its viscosity structure, something that we need to know to quantify the internal dynamics of the mantle - the convective process and thermal history of the planet. By 'Earth' I quickly learned two things: That I would have to examine the broad time-spectrum – from the seismic band of seconds to the geological band of up to 10^8 years and longer – from essentially elastic response at the one end to near-fluid response at the other; and that I had to consider the planet as a whole, including its fluid regimes with their interactions between themselves and with the Earth. I and my colleagues have worked through a range of physical processes that deform the Earth, mostly with 'geodetic' observations as our starting point: the Earth's tidal deformations; the planet's irregular rotation; the rheological inferences of the Earth's gravity field, both on mantle and lithospheric scales; providing new insights into not only the Earth but also about the fluid regimes themselves. None of these results represent the final word but the essential messages today are the same: that we cannot treat any part of the Earth in isolation of the other parts if we wish to advance the understanding of the Earth; and no single discipline can solve any one of the questions raised about this Earth-system. Integrated, multi-disciplinary research is not just a platitude. It is essential!

ISSI Postdoc Teodolina Lopez with Kurt Lambeck, Johannes Geiss Fellow 2016.

Teodolina Lopez: What was your main project during your visit at ISSI?

Kurt Lambeck: I must change the 'was' to 'is', for the work is not complete and will continue for some time yet. Geodesy deals with the determination of the Earth's gravity field, with the establishment of a globally unified coordinate reference system (sensu lato). It is the glue that ties much of Earth-observation science and inter-planetary science together, and without which the latter would be very much the poorer. This is one message that I have been trying to emphasize at ISSI. The accuracies that have been achieved in recent years have been remarkable, from tens of meters in the 1960's to millimeters today and from it has emerged an entirely new high-frequency spectrum of time dependencies in the planets shape, gravity and rotation that needs to be understood and be predictable in order to maintain the global reference system at the now requisite accuracies. Of these signals, the particular process that I have been looking at is the change in the gravity, shape, and rotation of the Earth, resulting from changes in the ice sheets and their concomitant redistribution of water in the oceans. These have two components; a 'palaeo' component from the ongoing response of the planet to past ice-sheet changes, and a 'modern' component resulting from the response to present-day melting of the residual ice sheets. These combined signals are seen in all satellite-based geodetic observations and if we want to understand the recent change and develop predictive models we need to understand the palaeo component.

Teodolina Lopez: From your personal point of view, what could be the next major steps in geodesy?
Kurt Lambeck: Two important issues are (i) ensuring continuity of the current important gravity and altimetry missions, and (ii) the development of an inter-calibration system. ESA and some of the European national space programs have played an important role in the current missions but greater attention needs to be given to follow-up missions to provide continuity, with increasing precision and resolution, as each of these new emerging observational systems become embedded into our science and very social structure. The second important development required is a platform for intercomparisons between the different tracking and sensing systems – as proposed by the European Geodetic Reference System in Space (E-Grasp) concept – a necessity for long-term reference frame stabilities and translating precisions into accuracies. If the geodetic glue is going to stick then such a mission is essential.

Furthermore the following scientists visited and worked at ISSI in the course of the twenty-second year:

Pavel Bakala, Silesian University, Opava, Czech Republic, working periods: 19.-26.7.2016 and 10.-14.10.2016.

Eric Gaidos, Dept. of Geology and Geophysics, University of Hawaii, Honolulu, USA, working period: 20.8.-19.9.2016.

George Gloeckler, Department of Atmospheric, Oceanic & Space Sciences, University of Michigan, Ann Arbor, USA, working period: 1.-21.11.2016.

Bill Hartmann, Planetary Science Institute, Tucson, USA, working periods: 12.-16.9.2016 and 5.-26.5.2017.

Peter Hoppe, Max-Planck-Institut für Chemie, Mainz, Germany, working period: 29.5.-17.6.2017.

Kurt Lambeck, Johannes Geiss Fellow 2016, working periods: 20.8.-25.9.2016 and 18.4.-1.6.2017.

Debora Lancová, Silesian University, Opava, Czech Republic, working period: 19.-26.7.2016.

Luisa Lara, Instituto de Astrofisica de Andalucia – CISC, Granada, Spain: working period: 2.8.-30.9.2016.

Ken McCracken, IPST, University of Maryland, College Park, USA, working period: 30.9.-27.11.2016.

Individual Scientists are invited for extended periods to work on scientific subjects at the forefront in areas of interest to ISSI. The results of this research are to be published as books or in major scientific journals, with appropriate acknowledgment to ISSI.

Herbert Palme, Institute for Mineralogy and Geochemistry, University of Cologne, Germany, working period: 10.9-10.10.2016.

Götz Paschmann, Max Planck Institute for Extraterrestrial Physics, Garching, Germany, working periods: 17.-21.10.2016 and 27.3.-2.4.2017.

Mario J. Pinheiro, Department of Physics, Instituto Superior Tecnico, Lisboa, Portugal, working period: 3.-18.2.2017.

Gilles Sommeria, WCRP World Climate Research Programme, Geneva, Switzerland, working periods:10.-13.10.2016, 21.-23.11.2016 and 15.-16.3.2017.

Luigi Stella, INAF - Osservatorio Astronomico di Roma, Italy, working period: 17.-24.7.2016.

Events and ISSI in the media at a glance

Events

12 October 2016: Pro ISSI talk "Gravitational Wave Astronomy: Listening to the Dark Side of the Universe!" with Karsten Danzmann.

10 November 2016: Meeting of the Science Committee.

11 November 2016: Meeting of the Board of Trustees and ISSI Dinner.

15 March 2017: Pro ISSI talk "Extrasolar Planets: a Laboratory to Confront the Theory of Planet Formation with Observations" with Christoph Mordasini.

10 May 2017: Pro ISSI talk "Return to Planet Earth: Understanding the Earth from Geodetic Space Observations" with Kurt Lambeck.

15-16 May 2017: Meeting of the Science Committee.

15 June 2017: Meeting of the Board of Trustees.

ISSI in the media

Interview with R.-M. Bonnet by Mathilde Fontez from the French Science & Vie Large, Public Magazine on the Yuri Milner Alpha Centaury Project, 7 July 2016.

Article "Schweizer wird Forschungschef der NASA", Neue Zürcher Zeitung, Donnerstag, 29 September 2016.

Interviews with R.-M. Bonnet and M. Falanga "From Bern to Beijing: Cultivating Collaboration for the Excellence of Space Science – At the Third Anniversary of the International Space Science Institute-Beijing", Bulletin of the Chinese Academy of Sciences, Vol. 30, No. 3, 30 September 2016.

TV interviews with R. Rodrigo "Rosetta End of Mission in the Newscast", Spanish Television-TVE and Tele 5, 30 September 2016.

Article "Von Heiligenschwendi zur NASA", die Sonntagszeitung, 2 October 2016.

Interview with R.-M. Bonnet "La fin d'une Odyssée hors norme" by Pierre-François Mouriaux of the French Air et Cosmos Magazine at the occasion of the last landing and End of Life of the ESA Rosetta Mission, 4 October 2016.

Article "Wer einen sicheren Job will, ist hier falsch", die Sonntagszeitung, 15 January 2017.

Article "Der Senkrechtstarter aus Heiligenschwendi", Tagesanzeiger, 21 January 2017.

TV Interview with R.-M. Bonnet "Legends of Space: Yuri Gagarin", Euronews Space, 16 February 2017.

Article "Der nächste Goldrausch spielt sich im Weltall ab", NZZ am Sonntag, 16 April 2017.

Alpbach Summer School 2016

The Summer School Alpbach is a major educational event in space sciences in Europe, held yearly, that has remained young, despite celebrating its 40th anniversary in July 2016. The Summer School was organized in its usual, idyllic setting in the Tirolean Alps, in the picturesque village of Alpbach. The topic was new, as every year, the 60 students selected from ESA member states were also new, as were most of the tutors and lecturers supporting the students during the two weeks of the Summer School. Yet, the continuity among the organizers, led by Michaela Gitsch, the Director of the Summer School on behalf of the Österreichische Forschungsförderungsgesellschaft (FFG), with support from ESA and ISSI, laid the strong foundations for the success of the 2016 edition.

This year's topic was "Satellite Observations of the Global Water Cycle". Water is a main driving element of the global climate system and a prerequisite for life on Earth. Among the most serious issues confronting society today are potential changes in the Earth's water cycle due to climate change. These changes will profoundly affect atmospheric water vapor concentrations, clouds, precipitation patterns, streamflow, and the quantity and quality of the freshwater supply for human consumption and enterprise. Understanding the water cycle and how it will be affected by climate change is a big challenge. A key information source for this task is Earth observation from space, providing the only viable means for comprehensive global monitoring of water in its gaseous, liquid and solid forms.

After the introductory lectures covering different aspects of the topic, the four student teams at the Summer School set out to design space missions, to provide observations that will help resolve some of the outstanding questions concerning the Earth's water cycle. The four mission proposals, presented to the Summer School Jury chaired by Roger Bonnet, provided the usual diversity, thanks to the imaginative way the students approached the topic. The Polar Precipitation SATellite (PoPSAT) aimed at observing snow and light rain at high latitudes, as well as snowfall at mid latitudes, using radars. The Water Vapour European-Explorer (WAVE-E) satellite is to measure the water vapour content and dynamics of the Upper Troposphere Lower Stratosphere (UTLS), an important region of the Earth's atmosphere. A special gap in current observations was to be filled by the Snow Water Equivalent (SWE) satellite that was to use a sophisticated altimetry system to provide measurements that enable a better modeling of the Earth's albedo radiation in climate models. The CoastSat mission proposed measuring water quality in coastal regions, rivers and lakes using remote sensing. All four mission proposals showed the extremely high quality of the students, their ability to work together, under time pressure and to end with highly credible scientific goals in innovative space research topics.

The opening of the 40th Summer School Alpbach on 12 July 2016. On this occasion, EURISY awarded the Hubert Curien Prize to the organizers of the Summer School. In the picture (from left to right): Peter Falkner (ESA, Head Tutor), André Balogh (ISSI/Imperial College London, Scientific Coordinator of the Summer School Alpbach), Ambassador Peter Jankowitsch, Michaela Gitsch (FFG, Director of the Summer School), Johannes Ortner (Founder of the Summer School), Dominique Tilmans (EURISY President), Andreas Geisler (FFG), Jan Wörner (ESA Director General), Wolfgang Baumjohann (Director, Space Research Institute OeAW), Pascale Ehrenfreund (Chair of the DLR Executive Board), Klaus Pseiner (Managing Director of the Austrian Research Promotion Agency FFG, Vice Chairman of the ESA Council), Stephaan de Mey (EURISY Secretary General).

This year also marked the 40th anniversary of the Summer School, celebrated in style, in the presence of its founder, Professor Johannes Ortner, the Director General of ESA, Jan Wörner and several leaders of European space agencies and institutes. The Summer School was presented with the bi-annual Hubert Curien award by Eurisy, for promoting space as an exciting and challenging enterprise among the young scientists and engineers of Europe.

André Balogh

International Space Science Institute Beijing

Group Picture of the Forum on "The Link between Solar Wind, Magnetosphere, Ionosphere" held in July 2016.

In the reported period, ISSI-BJ organized two Forums to discuss the science goals of specific space missions and families of missions and help identify the related technology needed to achieve these science goals:
- A Forum on "The link between Solar wind, Magnetosphere, Ionosphere" was dedicated to the discussion of the joint NSSC-ESA mission SMILE in July 2016;
- A Forum on "Lunar and Planetary Seismology" was dedicated to an analysis of the potential of seismology as a tool to understand the internal structure and activity of planetary bodies in January 2017.

To make the Forum discussions and its conclusions accessible to the broad scientific communities and the public, the insights gained from these Forums are published in the ISSI-BJ TAIKONG Magazine. The issue dedicated to the first Forum, "The link between Solar wind, Magnetosphere, Ionosphere" has been published as No. 9 of the magazine. It can be downloaded from the website www.issibj.ac.cn.

Furthermore, ISSI-BJ successfully held the first joint Space Science School on "How to Design a Space Science Mission" with the Asia-Pacific Space Cooperation Organization (APSCO) in October 2016 in Thailand. The Space Science School provided the students, who were from Asia-Pacific, Russia, Australia and USA, with in-depth knowledge on specific space science topics and on space mission engineering, acquainted them with the leading experts in the field and motivated them to pursue a career in space sciences. The School also intended to build links between all participating countries and their students, some of whom may have the potential to become leaders in the future by developing their abilities to work in a multidisciplinary international team.

The International Space Science Institute in Beijing (ISSI-BJ) was jointly established by the International Space Science Institute (ISSI) and the National Space Science Center (NSSC) with the support of the International Cooperation Bureau and the Space Science Strategic Project of the Chinese Academy of Science (CAS). ISSI-BJ is a close cooperation partner of ISSI. Both institutes share the same Scientific Committee, the same study tools, and other information of mutual relevance and interest. However, both use independent operational methods and different funding sources. More information can be found on its website: www.issibj.ac.cn.

As a result of two ISSI-Beijing Workshops held in 2014 and 2015, two special issues of Space Science reviews presenting the outcomes of these Workshops were published at the end of 2016: "Gamma Ray Bursts-A Tool to Explore the Young Universe", and "From Disks to Planets: The Making of Planets and their Early Atmospheres".

ISSI-BJ is promoting outreach and education activities to the general public and to young scientists as a member of the "Understanding Science" seminars. ISSI-BJ held three of these scientific seminars, namely "Stardust: The Cosmic Seeds of Life" in February 2017, given by Professor Sun Kwok of the University of Hong Kong, "Exploring Mars" in March 2017, by Dr. Jeremie Lasue of IRAP, Toulouse, and "Observing the Changing Global Ocean Water Cycle from Satellite: A Major Scientific, Technological and Data Analysis Challenge" in June 2017, by Professor Lisan Yu of the Woods Hole Oceanographic Institution (WHOI). Around 50 young people attended each of these lectures. At the beginning of 2017, ISSI and ISSI-BJ released a joint Call for Proposals for International Teams in Space and Earth Sciences. Seven excellent teams have been selected by the Science Committee and they will hold a series of meetings at the Institute in Beijing. Three out of seven teams will share the meetings between Beijing and Bern. Together with the six teams selected in 2015/2016, ISSI-BJ will be hosting a total of 13 International Teams in the upcoming year, while six teams were hosted in the reporting period 2016-2017.
As this reporting period was marked by a smooth transition between two executive Directors terms, the incoming Director, Michel Blanc, wishes to emphasize the outstanding legacy he received from his predecessor, Maurizio Falanga, who will remain in all memories as the uniquely dedicated and talented founding Director of ISSI-Beijing.

Lijuan En and Michel Blanc

Listed are activities in which ISSI staff scientists participated between 1 July 2016 and 30 June 2017. This includes presentations given, meetings attended, honors received, and chairmanships held.

Presentations

25 August 2016 – N. Champollion: Decrease of the snow density near the surface at Dome C between 2002 and 2011, XXXIV SCAR conference, Kuala Lumpur, Malaysia.

1 September 2016 – N. Champollion: Sea Level Observation, The Revolution of Space Gravimetry Remote Sensing, ISSI-BJ & NSSC, Beijing, China.

21 September 2016 – N. Champollion: An imperative to monitor Earth's energy imbalance, CLIVAR open science conference, Qingdao, China.

22 September 2016 – A. Cazenave: Present-day sea level change at global and regional scales, CLIVAR open science conference, Qingdao, China.

22 September 2016 – N. Champollion: Assessment of the 20th century regional sea level rise in historical runs of climate models by comparison with tide gauge observations and Assessment of 20th century global mean sea-level rise in climate models compared to observations (Poster), CLIVAR Open Science Conference, Qingdao, China.

30 September 2016 – R. Rodrigo: Overview of the scientific results from Rosetta, ESAC-Rosetta end of Mission, European Space Astronomy Center, Madrid, Spain.

7 October 2016 – R-M. Bonnet: Surviving 1000 Centuries. Can we do it? A new Approach to Managing our Use of the Earth, ESA Head Quarter, Paris, France.

17 October 2016 – R-M. Bonnet: Space Science: A tool for International Cooperation, 1st APSCO & ISSI-BJ Space Science School, Sirindhorn Center for Geo-Informatics, Chomburi, Thailand.

18 October 2016 – R-M. Bonnet: ESA Past, Present and Future Space Science Program, 1st APSCO & ISSI-BJ Space Science School, Sirindhorn Center for Geo-Informatics, Chomburi, Thailand.

18 October 2016 – A. Cazenave: Sea level changes and coastal impacts, Coastal dynamics and ecosystem change: Caribbean, Bonaire.

27 October 2016 – R-M. Bonnet: From Giotto to Rosetta, 30 years of Cometary Science from Space and Ground, Centro di Ateneo di Studi e Attività Spaziali "Giuseppe Colombo, Università degli Studi di Padova, Italy.

31 October 2016 – A. Cazenave: 25 years of high-precision satellite altimetry What have we learned? What are the new challenges?, New Era of Altimetry, Eumetsat Symposium, La Rochelle, France.

23 November 2016 – A. Cazenave: "Global and regional sea level change", Norwegian Environmental Research Center, Bergen, Norway.

29 November 2016 – R. Rodrigo: Lecciones de la misión Rosetta: ¿Qué hemos aprendido de los cometas?, Universidad de León, León, Spain.

12 December 2017 – A. Cazenave: Closure of sea level and mass budgets during the altimetry era, AGU Fall meeting, San Francisco, USA.

12-16 December 2016 – R. von Steiger: Solar metallicity derived from in-situ solar wind composition (Poster), Fall Meeting of the AGU, San Francisco, USA.

6 January 2017 – A. Cazenave: El Nino, Royal Academy of sciences, Brussels, Belgium.

9 January 2017 – M. Falanga: Millisecond X-ray pulsars: 15 years of progress, National Central University, Taoyuan, Taiwan.

20 January 2017 – R-M. Bonnet: Space Science in Europe, Seminar, Laboratoire d'Astrophysique de Marseille, France.

22 February 2017 – A. Cazenave: Océans, glaces, niveau de la mer et climat, Academy of sciences of Morocco, Rabat, Morocco.

23 February 2017 – R-M. Bonnet: Coopération Internationale dans la Recherche Scientifique Spatiale, Université Inter-âge, Créteil, France.

1 March 2017 – R. von Steiger: Wasser in unserem Sonnensystem – und darüber hinaus, Rotary Club Burgdorf, Switzerland.

16 March 2017 – M. Falanga: Stellar evolution until forming AMXPs, Silesian University in Opava, Czech Republic.

Staff Activities

23 March 2017 – R-M. Bonnet: Obituary of Professor Ichtiaque Rasool, Paris Observatory, France.

24 April 2017 – T. Lopez: Contribution of thermal infrared images on the understanding of the subsurface/atmosphere exchanges on Earth and Influence of the surface permeability on the GRACE water mass variations, Case of the Lake Chad basin, EGU, Vienna, Austria.

19 May 2017 – R-M. Bonnet: A Vision of the Present and the Future of Space Science Research, Space Academy, Thales Alenia Space, Torino, Italy.

22 May 2017 – R-M. Bonnet: Survivre 1000 Siècles, Grandes Conference de Verviers, Belgium.

23 May 2017 – R-M. Bonnet: Inventer une Mission Spatiale: l'Innovation fille de l'Audace, Seminar, Centre Spatial de Liège, Belgium.

30 May 2017 – A. Cazenave: Remote sensing of the oceans: Focus on satellite altimetry and sea level, University of Zurich, Switzerland.

31 May 2017 – R-M. Bonnet: Developing a Space Mission at ESA, Lecture to the Principal Investigators of future Chinese Space Science Missions, National Space Science Center, Huairou, China.

21 June 2017 – F. Effenberger: Investigating the connection between RHESSI X-ray and AIA DEM heating signatures in solar limb flares, RHESSI Workshop, University of Boulder, CO, USA.

22 June 2017 – A. Cazenave: Contemporary Sea Level Change: From Global to Local, Observations and Causes What have we learned from the observations? What are the new challenges?, University of Hamburg, Germany.

Meetings

4 July 2016 and 11-13 January 2017 – R. von Steiger: Evaluation Commission of SNSF professorship proposals, Bern, Switzerland.

11-15 July 2016 – A. Bykov: The 6th International Symposium on High-Energy Gamma-Ray Astronomy, Heidelberg, Germany.

12-21 July 2016 – R-M. Bonnet: Alpbach Summer School, Jury Chair, Austria.

12-21 July 2016 – S. Wenger: Alpbach Summer School, Austria.

19-21 July 2016 – R. Rodrigo: Alpbach Summer School, Austria.

13-16 September 2016 – A. Bykov: Beyond a PeV Particle acceleration to extreme energies in cosmic sources, Institut d'Astrophysique de Paris, France.

18-24 September 2016 – A. Bykov: Cosmic Ray Origin – beyond the standard models, San Vito di Cadore, Dolomites, Italy.

26 September 2016 – R. Rodrigo: Jury of the Awards Spanish Royal Society of Physics – BBVA Foundation, Madrid, Spain.

30 September 2016 – R-M. Bonnet: End of Rosetta Event, ESOC, Darmstadt, Germany.

30 September 2016 – R. Rodrigo: ESAC-Rosetta end of Mission, ESAC, Madrid, Spain.

5 October 2016 – R-M. Bonnet: Solar Orbiter Contamination Control Review meeting, ESTEC, The Netherlands.

6-7 October 2016 – M. Falanga: GA meeting "Swiss Society for Astrophysics and Astronomy", Davos, Switzerland.

7 October 2016 – R-M. Bonnet: A new Approach to Managing our Use of the Earth System, The Safe Operating Space Treaty, ESA Head Quarters, Paris, France.

17-18 October 2016 – R-M. Bonnet: The 1st APSCO and ISSI-BJ Space Science School, Sirindhorn Center for Geo-Informatics, Chomburi, Thailand.

14 November 2016 – R. von Steiger: Evaluation Commission of Marie Heim-Vögtlin Fellowships of the SNSF, Bern, Switzerland.

7-9 December 2016 – A. Bykov: Sources of Galactic cosmic rays at APC, Paris, France.

26 January 2017 – R-M. Bonnet: Alpbach Summer School 2017, 2nd Program Committee, Vienna, Austria.

17 February 2017 – R-M. Bonnet: Institut Français d'Histoire de l'Espace (IFHE) Board meeting, Paris, France.

20-27 February 2017 – A. Bykov: "SN 1987A, 30 Years Later", Astronomical Union Symposium, Saint-Gilles-les-Bains, La Reunion Island.

28 February - 2 March 2017 – A. Bykov: The extreme Universe, Padova, Italy.

20-23 March 2017 – S. Wenger: COSPAR Bureau Meetings, Paris, France.

23 March 2017 – R-M. Bonnet: Ichtiaque Rasool Memorial Day, Paris Observatory, France.

5 December 2016 – R-M. Bonnet: Alpbach Summer School 2017 1st Program Committee, Vienna, Austria.

6 April 2017 – R-M. Bonnet: Presentation of the History of the Hermès Space Shuttle, IFHE/CNES Paris, France.

9-14 April 2017 – R. Rodrigo: Asteroids, Comets, Meteors: ACM 2017, Montevideo, Uruguay.

23 April 2017 – R. von Steiger: Editorial Committee of Space Science Reviews, Vienna, Austria.

12 May 2017 – J. Zarnecki: Titan; The Moon that Thinks it's a Planet, Presidential Address, Royal Astronomical Society, London, United Kingdom.

19 May 2017 – R-M. Bonnet: Visit Thales Alenia Space and Meeting of the Space Academy, Torino, Italy.

22-24 May 2017 – R. Rodrigo: Osiris Full Team Meeting, Torrejón de Ardoz, Spain.

23-24 May 2017 – R. von Steiger: Forum on Small Satellites for Space Science (4S), ISSI, Switzerland.

26 May - 3 June 2017 – R-M. Bonnet: visit to NSSC, Huairou, Beijing, China.

29 May - 3 June 2017 – A. Bykov: Ginzburg Centennial Conference on Physics, Lebedev Institute Moscow, Russia.

30-31 May 2017 – R. von Steiger: Symposium in Cultural and Social Geography for the succession of Prof. Wastl-Walter, University of Bern, Switzerland.

1-3 June 2017 – R-M. Bonnet, R. Rodrigo, M.Blanc: ISSI-Beijing Board of Trustees, Beijing, China.

12-13 June 2017 – R. von Steiger: Editorial Board of Living Reviews in Solar Physics, Heidelberg, Germany.

13-17 June 2017 – M. Falanga: "HXMT launch", Jiuquan Satellite launch center, China.

14 June 2017 – R-M. Bonnet: Solar Orbiter Contamination Control Review meeting, ESTEC, The Netherlands.

20-21 June 2017 – R. Rodrigo: Multi-instrument Analysis of Rosetta Data (MiARD) project (H2020 686709) review meeting, Brussels, Belgium.

20-24 June 2017 – F. Effenberger: RHESSI Workshop session co-organizer: Working Group leader of WG1 - Electron acceleration and transport, University of Boulder, CO, USA.

Staff Activities

Chairman- and Memberships, Honors

R.-M. Bonnet:
- Board Member of the Association Française d'Astronomie, France
- Vice-President of Institut Français d'Histoire de l'Espace, France
- President of IFHE's Prix Aubinière Award, France
- President of the Alpbach Summer School Jury 2016 and 2017, Austria
- Co-President of the ESA Solar Contamination Review of the ESA Solar Orbiter Mission
- Senior Advisor to the NSSC Director General for ISSI-BJ matters
- Reviewer of the Space Project L'espace, Impératif économique et culturel, and Adviser to the Team of Jacques Cheminade, Candidacy for the Presidency of French Republic 2017 elections
- "Roger Bonnet" name given by the International Astronomical Union to the Main Belt Asteroid, preliminary designated 1999 LD20 now called 18627Rogerbonnet and discovered on 1988-02-27 at Cima Ekar Astrophysical Observatory by M. Tombelli of Asiago Observatory and C. Casacci of Thales Alenia Space (19 May 2017)

A. Cazenave:
- Member (Officer) of the Joint Scientic Committee of the World Climate Research Programme
- Member of the panel "Powering science: NASA's Large Strategic Science Missions" of the National Research Council, The National Academies, USA
- Member of the Conseil d'Administration of Meteo-France
- Member of the Conseil d Orientation Strategique of the Institut de Recherche pour le Développement (IRD)
- Guest editor of PNAS
- Nansen Polar Bear Award of the Norwegian Nansen Center (2016)
- NGRI-AHI (National Geophysical Research Institute and -Indian Association of Hydrology) Life Time Achievement Award (2017)

M. Falanga:
- Member of the Astronomy & Astrophysics Journal Board of Directors, Swiss representative since 2011
- Member of the International Astronomical Union (IAU)
- Member of the International Academy of Astronautics (IAA)

R. Rodrigo:
- Member of the Arecibo Observatory Science and Management Advisory Committee
- Member of the International Academy of Astronautics Scientific Activities Committee
- Member of the Editorial Board of Space Science Reviews
- Member of the Scientific Advisory Committee of the BBVA Foundation
- Co-Investigator of the Instrument "Giada" of the ESA Mission Rosetta for the exploration of minor bodies in the Solar System
- Spanish Lead Scientist of the "Osiris" instrument of the ESA Mission Rosetta for the exploration of minor bodies in the Solar System
- Co-Investigator of the BepiColombo Laser Altimeter of the ESA Mission BepiColombo to planet Mercury
- Co-Investigator of the Instruments Janus and Gala of the ESA Mission JUICE for the exploration of the Jovian system

R. von Steiger:
- Member of the Evaluation Committee for Swiss National Science Foundation Professorships
- Member of the Evaluation of Maria Heim-Vögtlin Grants
- Co-chair of the Cospar Roadmap Committee on Small Satellites for Space Science (4S)
- Full Member of the International Academy of Astronautics (IAA)

J. Zarnecki:
- Chair of ESA's Space Science Advisory Committee
- President of the Royal Astronomical Society
- Member of Council of The Institute of Physics
- Member of the Google Lunar XPrize Judging Panel
- Awarded Doctor Honoris Causae, Polish University Abroad, London (14 October 2016)

Listed are all papers written or co-authored by ISSI staff that were submitted or that appeared between 1 July 2016 and 30 June 2017.

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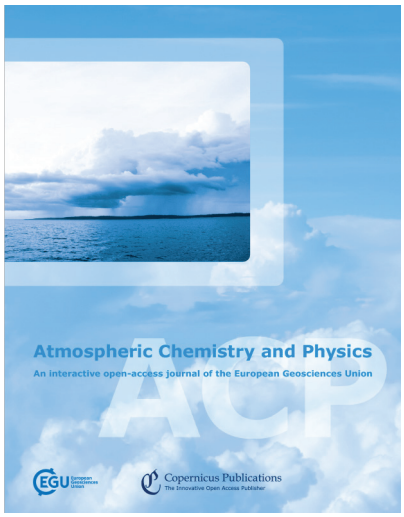

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Table of Contents

Reviews and syntheses: Systematic Earth observations for use in terrestrial carbon cycle data assimilation systems
M. Scholze, M. Buchwitz, W. Dorigo, L. Guanter, S. Quegan
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Table of Contents

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Table of Contents

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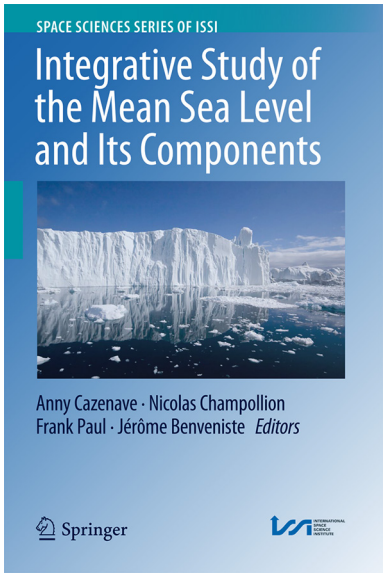

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Table of Contents

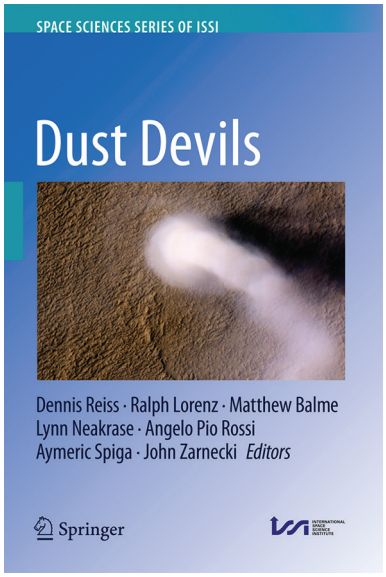

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Table of Contents

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Table of Contents

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Table of Contents

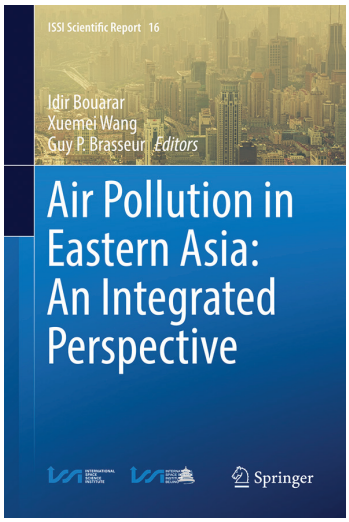

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Table of Contents

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