

Royal Belgian Institute for Space Aeronomy – BIRA-IASB

Fostering basic, interdisciplinary and applied research

A Belgian federal scientific research institute that celebrated its 50th anniversary in 2014, the Royal Belgian Institute for Space Aeronomy (BIRA-IASB) is dedicated to research and scientific service in space aeronomy, which is the physics and chemistry of the atmosphere of the Earth and other planets, and of outer space.

With an annual budget of around 10 million euros per year, BIRA-IASB relies on a staff of 155 people, including 90 scientists, and is currently involved in around 130 ongoing research projects. These are rather good figures as government funding is under pressure and falling. “BIRA-IASB increasingly requires external funding in the form of research projects in order to maintain its activities” explains Martine De Mazière, ad interim general director of BIRA-IASB. “We must make more and more efforts in order to find research projects that are increasingly limited in time and funding.” As a result, the staff must be shared between several projects simultaneously. This is far from being obvious, neither for the researchers themselves nor for BIRA-IASB which is responsible for the administrative management of these projects.

Since its internal reorganization in 2012-2013, BIRA-IASB is structured in four vertical pillars corresponding to its 4 major research themes. Added to these are 8 horizontal support services: Administration & accounting, project management, human resources, outreach & documentation, infrastructure management, safety & prevention, engineering and IT.

As stated above, BIRA-IASB’s research is revolving around four main themes: space physics, atmospheric composition (sources and sinks, reactive gases) and the study of interactions between the atmosphere and the sun, which includes the planetary aeronomy.

Thanks to this hyper specialized expertise, BIRA-IASB is involved in many projects of the European Space Agency (ESA) and the European Commission. For example, it is very much involved in Copernicus, a joint program of ESA and the European Commission. In this context, it participates in the preparation of space missions Sentinel 4 and Sentinel 5; the precursor of Sentinel 5, called TROPOMI, will be launched in Spring 2017. This is a new generation of the OMI satellite experiment: dedicated to monitoring the overall quality of the air, it will benefit from an improved resolution down to 7x7 square kilometers and will map the Earth atmosphere every day, which will provide us with an accurate monitoring, almost in real time, of our planet. BIRA-IASB is involved in the production of future products that will be generated by this satellite, products for which it will also

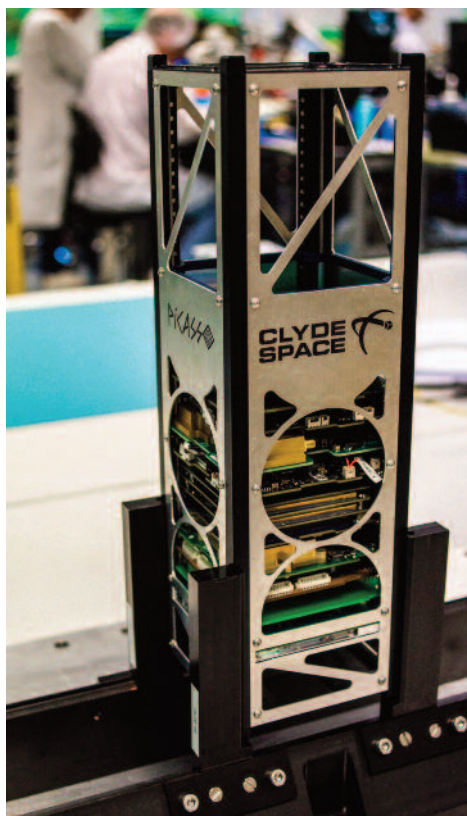
provide both validation and geophysical exploitation. “In addition, the amount of data generated by TROPOMI every day (of order 650 GByte/day) poses enhanced problems in terms of storage and computing power” says Martine De Mazière. The IT service of BIRA-IASB will thus be called upon to support the storage and analysis of the measurements of nitrogen dioxide, ozone, formaldehyde, carbon monoxide (a precursor of ground level ozone) and methane, that will be dealt with at BIRA-IASB. The methane measurements are particularly interesting to learn more about the state of climate.

Next to the space segment, the Copernicus program also contains a services segment. BIRA-IASB participates actively to two Copernicus service elements: atmosphere monitoring (CAMS) and climate change (C3S). “We are coordinating a C3S project focusing on ozone satellite records that is about to start and we are partner in another C3S proposal that has been submitted end of summer 2016 and that is focusing on climate records from reference in-situ networks.” says Martine De Mazière. “Climate change is increasingly emphasized –

which is quite logical since it is a major global challenge.” Anyway, ESA is willing to extend its Climate Change Initiative (CCI) programme, which addresses various key variables for the climate, such as ozone, aerosols and greenhouse gases. This extension should be confirmed at the end of 2016 at a ministerial conference and BIRA-IASB intends to remain involved in this initiative.

But BIRA-IASB’s participation in ESA programs do not stop there. The Institute is also Principal Investigator of PICASSO, the future Cubesat in-orbit demonstrator which should be launched in 2017, and of ALTIUS, a Belgian satellite accepted by ESA as an Earth Watch mission. “This is a real success! We are aiming at a launch in 2020” welcomes Martine De Mazière. Moreover, BIRA-IASB is involved in the programme entitled “Space Situational Awareness” with space weather activities, and it regularly responds to ESA’s calls for space exploitation projects and new missions.

BIRA-IASB has been involved in the successful ROSETTA mission that produced a wealth of new insights in cometary sciences. The mission ended in September 2016 but the exploitation of the data is still ongoing and more scientific results are expected to come.



A picture of the triple cubesat platform developed by Clyde Space that will carry the payloads Vision and Sweeping Langmuir Probe developed by BIRA-IASB that will constitute PICASSO, the Pico-Satellite for Atmospheric and Space Science Observations.

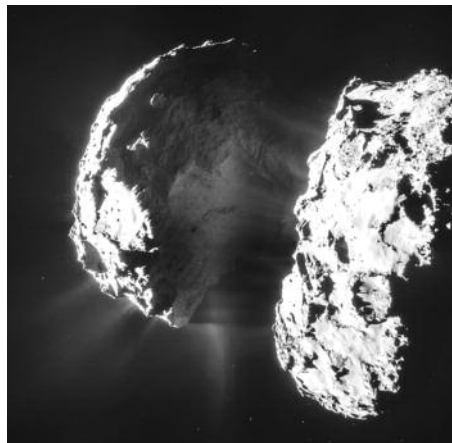
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Innovation Technology





As part of the first ExoMars mission of ESA, launched in March 2016, the Institute is Principal Investigator of the NOMAD instrument, that has arrived in an orbit around Mars in November 2016. "All tests show that this instrument works" confirms Martine De Mazière. Actually, at the end of November 2016, there was the NOMAD commissioning. On 20/11, NOMAD was switched on, on 22nd of November NOMAD was in its closest position to Mars and on 23rd-24th the first scientific data were sent to Earth. On 22nd, we officially had confirmation that NOMAD was working correctly. A press release on 28th of November displayed the first science results. To be sure, this mission is already seen as a major event by BIRA-IASB.



A picture of the comet 67P/Churyumov-Gerasimenko on which Philae landed while Rosetta continued to orbit the comet, until it descended and collided with the comet on September 30, 2016, as planned.

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the basis for the further development of instruments or instrument components. "A prototype developed by our engineering service can be "recovered" by an industrial company that will support further testing and/or eventually launch the production" explains Martine De Mazière. Such a paired work is clearly visible in the missions ALTIUS (the design of an optical spectrometer was conducted by the OIP company based in Oudenaarde) and NOMAD (almost all tests for calibration and resistance to thermal vacuum were conducted at the Space Center in Liege). But the original design mostly starts from BIRA-IASB: testimony of this is the mechanical system developed as part of the NOMAD instrument in order to sound the atmosphere by targeting either the sun or the surface of the planet.

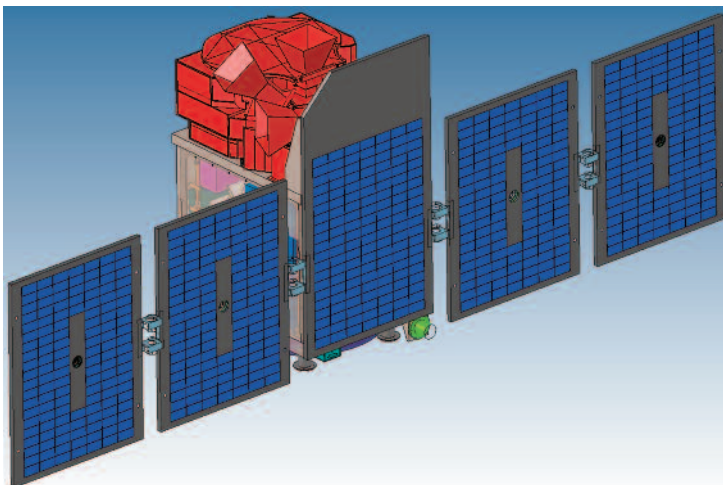
H2020, the 8th Framework Programme of the European Commission for research and technological development, provides BIRA-IASB another opportunity to enhance its expertise. Since the signing in 1987 of the Montreal Protocol on Substances that Deplete the Ozone Layer, the World Meteorological Organization publishes an assessment of the state of the ozone layer every four years. BIRA-IASB participates in these reports through peer-reviewed publications and dedicated contributions. The Montreal Protocol and its Adjustments and Amendments, relying on this continuous monitoring of the ozone layer, have led to a positive effect: the ozone layer is beginning to recover thanks to the reduction of gases targeted by the Montreal Protocol but also due to climate change that has a side-effect of accelerating the ozone recovery. "According to a recent publication in Science, the ozone hole over Antarctica would also be verging to heal," says Martine De Mazière. These good news are complemented by the continuation of an initiative launched in 2011 to establish trends at different altitudes in the atmosphere, based on satellite and ground-based observations. Unsurprisingly, BIRA-IASB co-leads this initiative.

BIRA-IASB is also expected to turn its scientific know-how into scientific services to the benefit of society. Although it does not directly provide services to industries, its research often offers

Accustomed to enroll in long-term missions, BIRA-IASB now meets some great challenges that its researchers will face in the coming years. The first challenge is climate change and monitoring of the ozone layer, which involve the collection of very long-term measurement time series. "Yet this collection is very difficult to maintain with core funding on the decline and few potential third-party support" complains Martine De Mazière. This is an ongoing challenge of pursuing research of which the results will not be seen before 10 years but that are essential for supporting climate change abatement strategies.

Another major challenge is to maintain a dynamic basic research at a time when the pressure to focus on applied research or operational services is growing. "It is increasingly difficult to raise funding for research projects that are not society-oriented or do not directly benefit the industry or economical sectors" says Martine De Mazière.

Last but not least, the third major issue ahead is a cultural one: the evolution towards interdisciplinary research. Today the atmosphere is studied in interaction with the biosphere, the land and oceans, human societies and space. "The socio-economic aspects of climate change are also taken into account" adds Martine De Mazière. The analysis of a whole system takes over that of a specific environment. Still BIRA-IASB has insufficient staff to follow this trend all by itself. It becomes more and more necessary to collaborate with other disciplines represented at universities and institutions, which requires to learn the language of other specialists. "BIRA-IASB will probably have to open up even more to the outside while hiring new kinds of specialists internally" concludes Martine De Mazière.



An engineering view of the ALTIUS mission with the solar panels deployed.

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