

## Österreichische Forschungsförderungsgesellschaft

*Innovation in Wissenschaft und  
Technik der Weltraumforschung:  
Österreichs Beiträge*

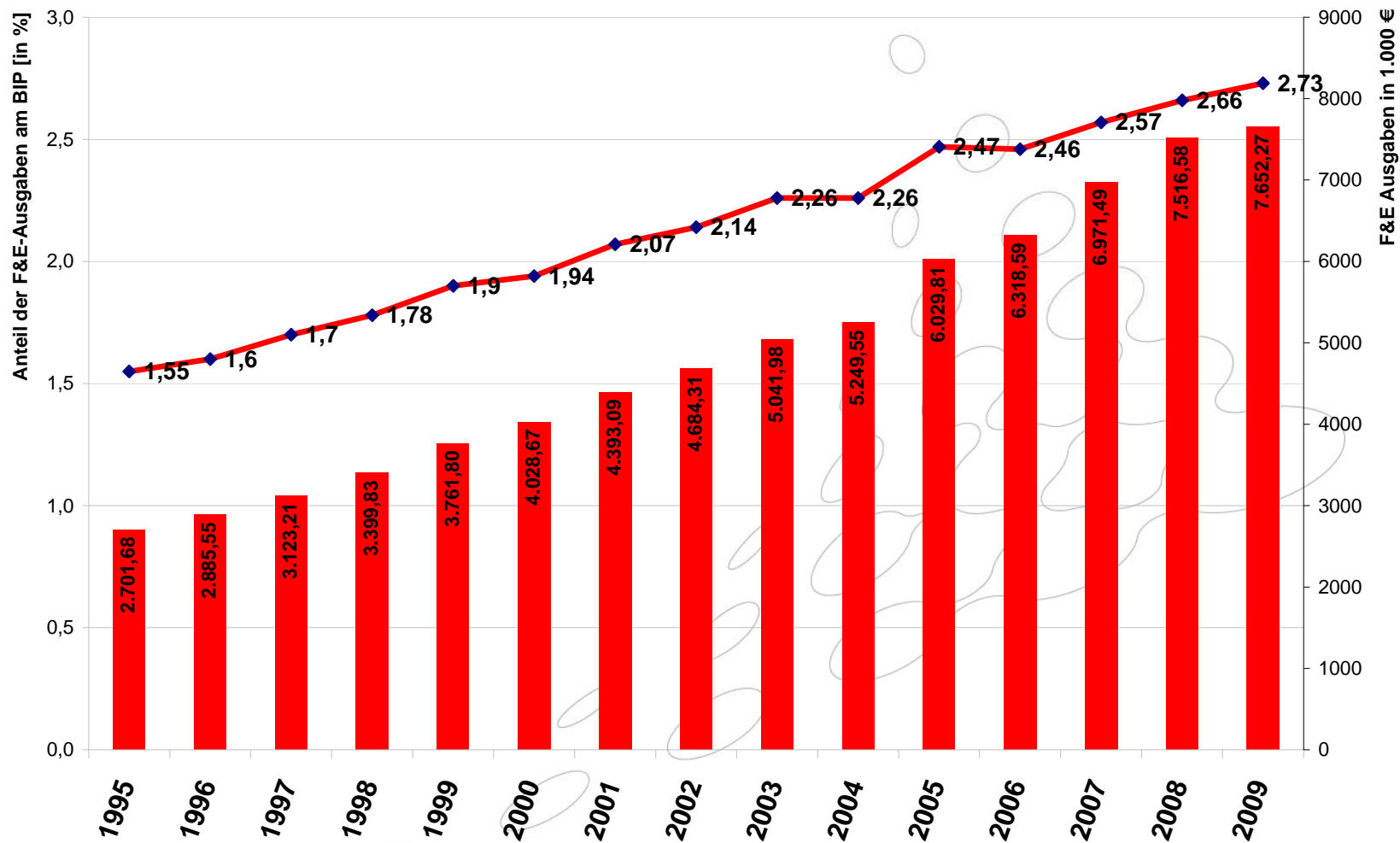
*Ref.: ALR-PPT-0184-2010rev0*

**Graz in Space 2010**  
9.-10. September

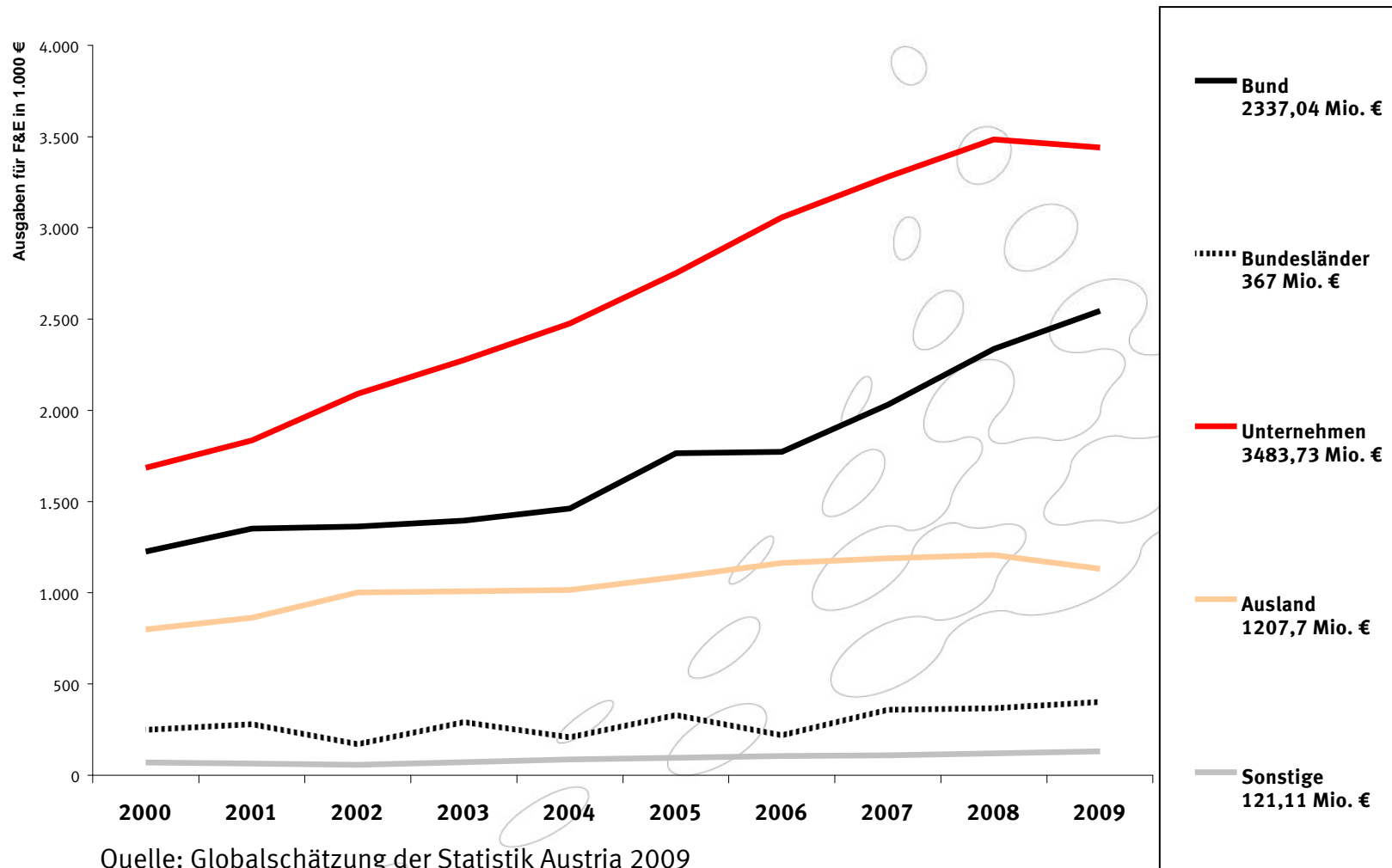


- Österreich = unter den EU27 von Platz 8 2007 auf den Platz 6 im European Innovation Scoreboard 2008
- Österreich befindet sich (nach wie vor) innerhalb der Gruppe der „Innovation followers“, ist dort aber an erste Stelle und nur knapp von der Gruppe der „Innovation leaders“ entfernt.
- Als Forschungs- und Innovationsstandort hat Österreich in den vergangenen Jahren sichtbar aufgeholt.
- Das zeigt sich nicht nur an den F&E-Ausgaben die in Österreich stärker und kontinuierlicher angestiegen sind als in den meisten anderen EU-Staaten

# ENTWICKLUNG DER F&E-QUOTE



# ENTWICKLUNG DER F&E-AUSGABEN



Quelle: Globalschätzung der Statistik Austria 2009

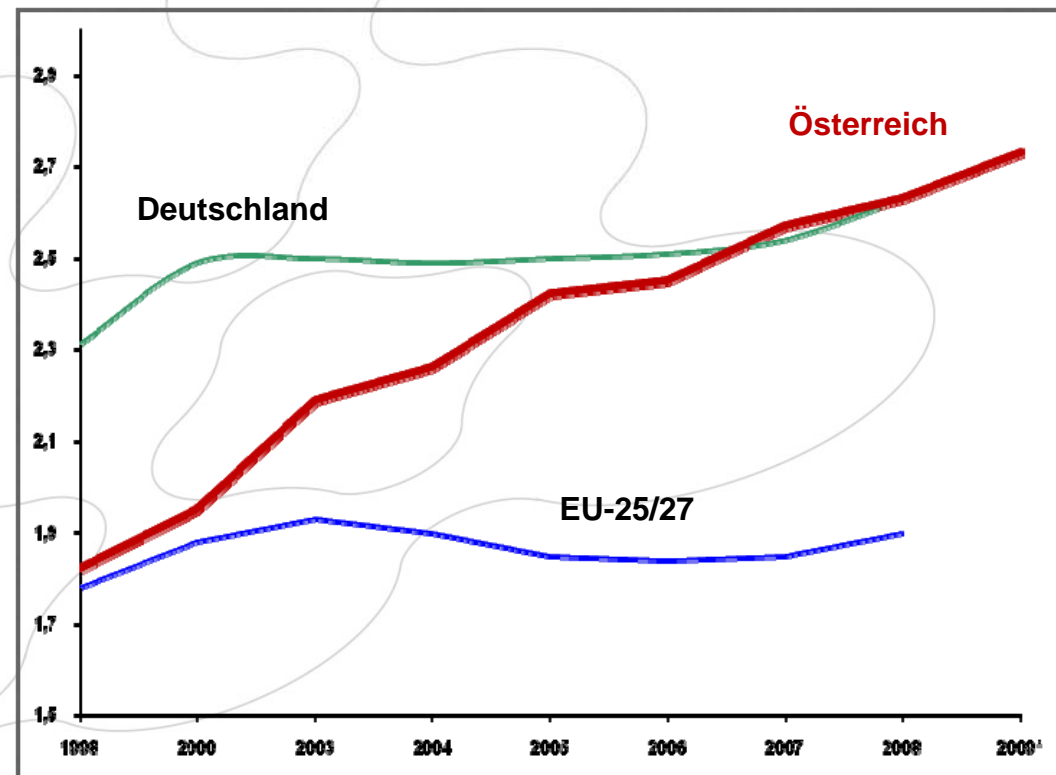
# BEEINDRUCKENDER WACHSTUMSPFAD: allerdings in der Rückspiegelperspektive



**Ziel: Österreich soll 2020 „Innovation Leader“ sein**

## Österreich = Top-Player im F&E-Bereich:

- F&E-Quote 2009: 2,73% des BIP » Rang 3 EU-weit hinter Schweden und Finnland (EUROSTAT)
- Platz 6 im European Innovation Scoreboard („Innovation Follower“)



F&E-Quote in % des BIP; Quelle: Eurostat; Grafik: ABA

FFG - FÖRDEREFFEKTE  
HOHE ADDITIONALITÄT DER FFG-FÖRDERUNGEN



- **Inputadditionalität:** FFG-Programme weisen eine langfristige Inputadditionalität von 1,85 auf. D.h., mit einem eingesetzten Förder-EURO werden langfristig 0,85 EURO zusätzliche private F&E-Investitionen ausgelöst *(Quelle: Joanneum Research 2007)*
- **Förderungsmultiplikator:** mit 1 EURO FFG-Förderungen (Basisprogramme) werden 19 EURO an zusätzlichen Umsätzen bzw. Lizenzeinnahmen ausgelöst *(Quelle: KMU Forschung Austria 2009)*
- **Arbeitsplatzeffekte:** mit 12.400 EURO an Förderbarwert wird durchschnittlich ein Arbeitsplatz geschaffen bzw. gesichert *(Quelle: KMU Forschung Austria 2009)*

## MEHR PROJEKTE TROTZ KRISE

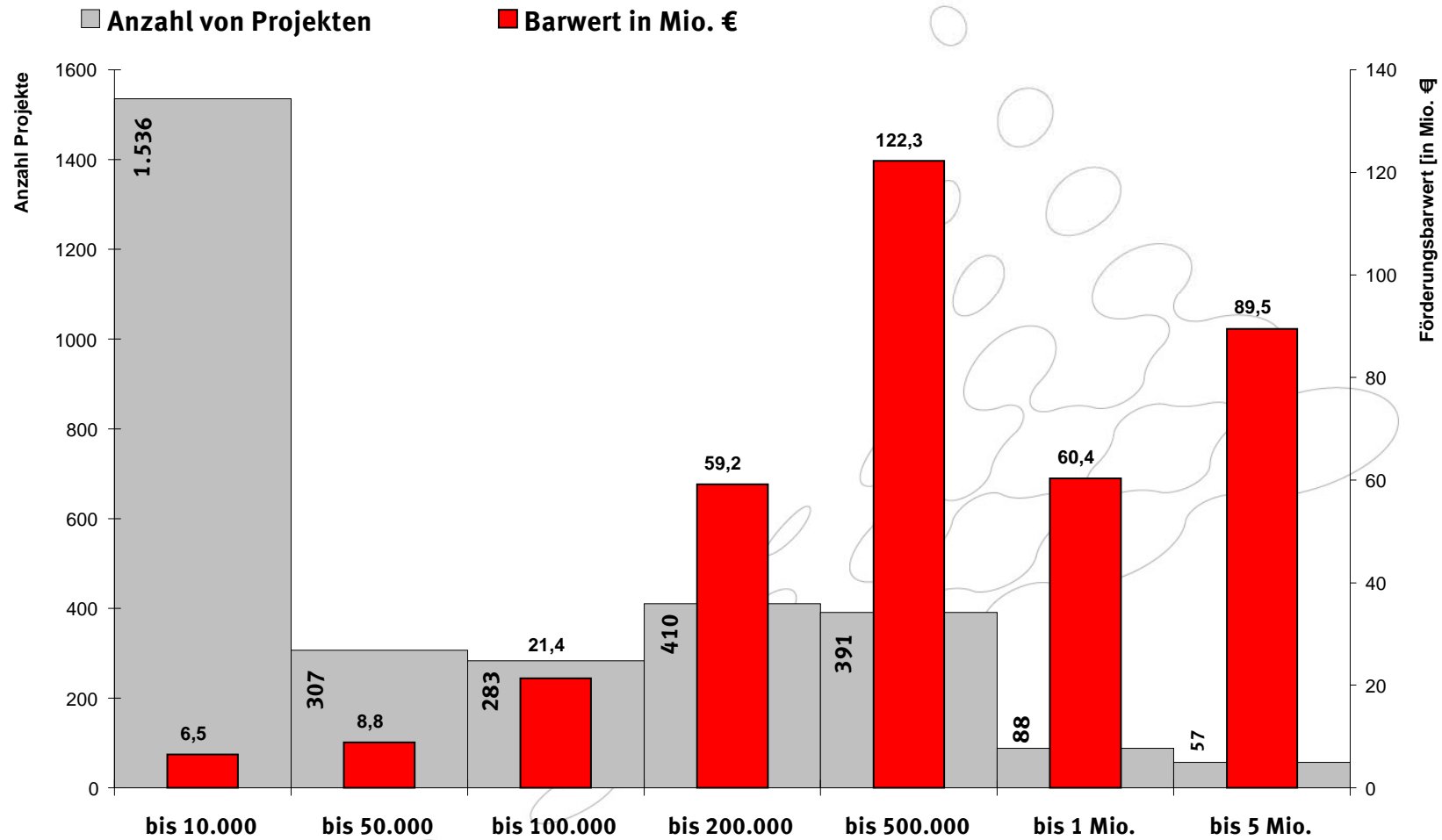
### FFG Förderstatistik 2009

	2006	2007	2008	<b>2009</b>	Veränderung
<b>Zugesagte Projekte</b>	1.221	1.805	2.545	<b>3.072</b>	+ 20,7%
<b>Beteiligungen (Vertrags- und Konsortialpartner)</b>	2.113	2.703	5.088	<b>5.220</b>	+ 2,6 %
<b>Förderzusagen</b>					
<b>Gesamtförderung</b>	447 Mio. €	406 Mio. €	548 Mio. €	<b>508 Mio. €</b>	-7,3%
<b>Barwert</b>	296 Mio. €	255 Mio. €	424 Mio. €	<b>371 Mio. €</b>	-12,5%
<b>Auszahlungen</b>	310 Mio. €	306 Mio. €	366 Mio. €	<b>378 Mio. €</b>	+3,3 %
<b>Mittelbindung</b>	xxx	586 Mio. €	652 Mio. €	<b>534 Mio. €</b>	-18,1%

Quelle: FFG Förderstatistik 2009

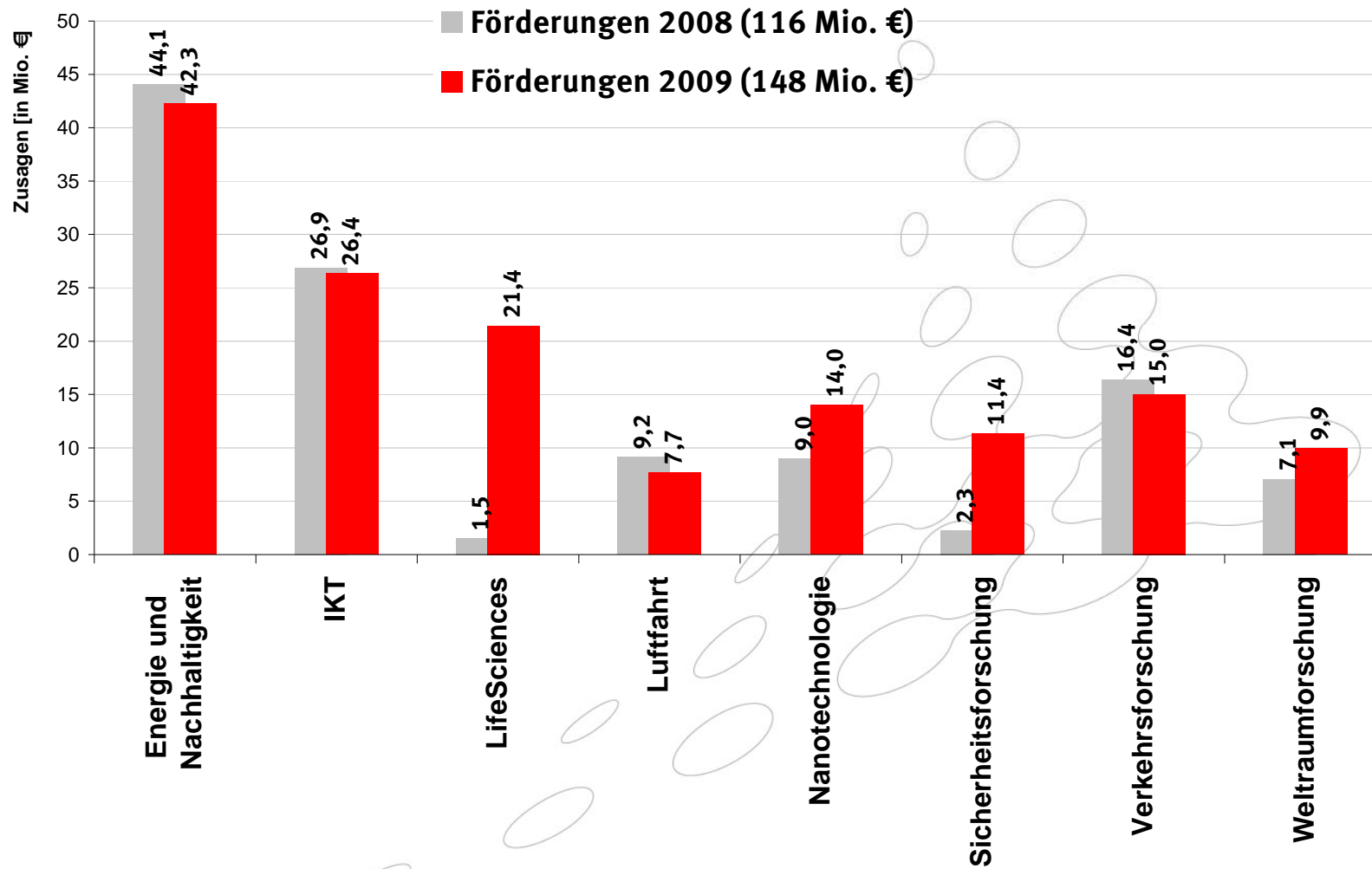
# FFG WIRKT.

## Basis verbreitern – Spitze stärken





# THEMATISCHE SCHWERPUNKTE



## Why shall we invest in Space? The Value of Space

### *Space as an integral part of our national innovation system*

- *Political Value*: International cooperation and European strategic interest (“infrastructure of the 21st century”)
- *Scientific excellence and international cooperation*
- *Economic Value and technical excellence*
- *Humanitarian Value*: for the benefit of society
- *Educational Value*: inspiring young generations and attracting best talents to science and engineering

# "Drei-Säulen-Modell"

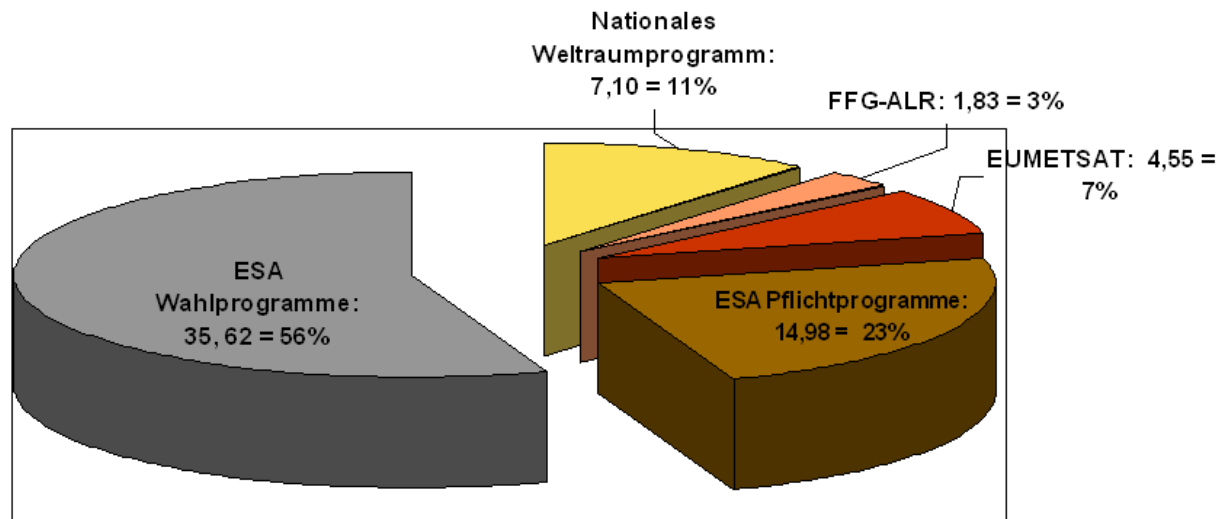
ESA	EU FP	ASAP
Pflichtprogramm	GMES GALILEO	Wissenschaft Technologie
Wahlprogramm	SSF - Security	Anwendungen

**ASAP als Hebelprogramm**

# Weltraum Budgets in Österreich



## Österr. Weltraumbudget 2010 in Mio.€ (Gesamt: 64,08)

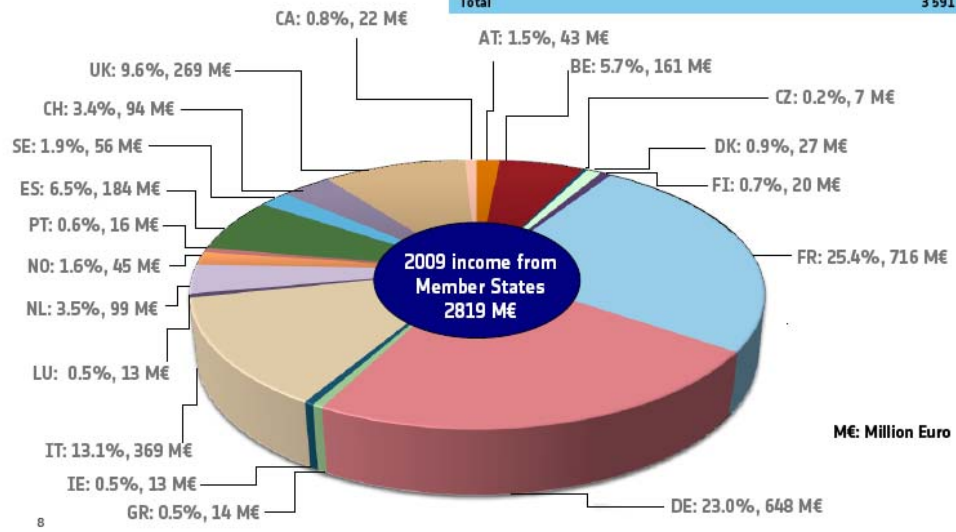


# ESA Budgets



## ESA BUDGET FOR 2009

Income from Member States and other states	2819 M€
Income from Member States, previous years	352 M€
Other income	420 M€
<b>Total</b>	<b>3 591 M€</b>

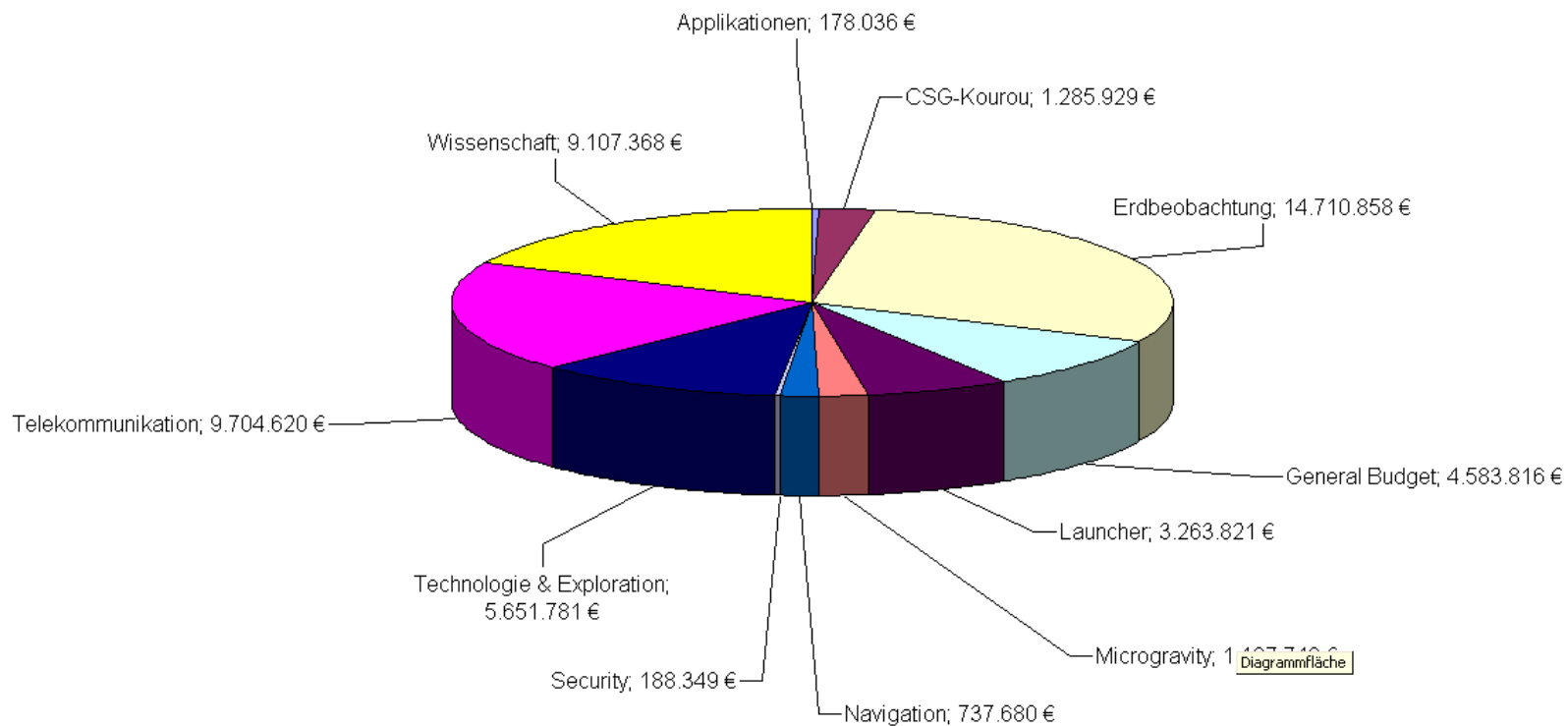


# ESA Budgets in Österreich



## ESA Budget 2010 (GESAMT 50,6 M€)

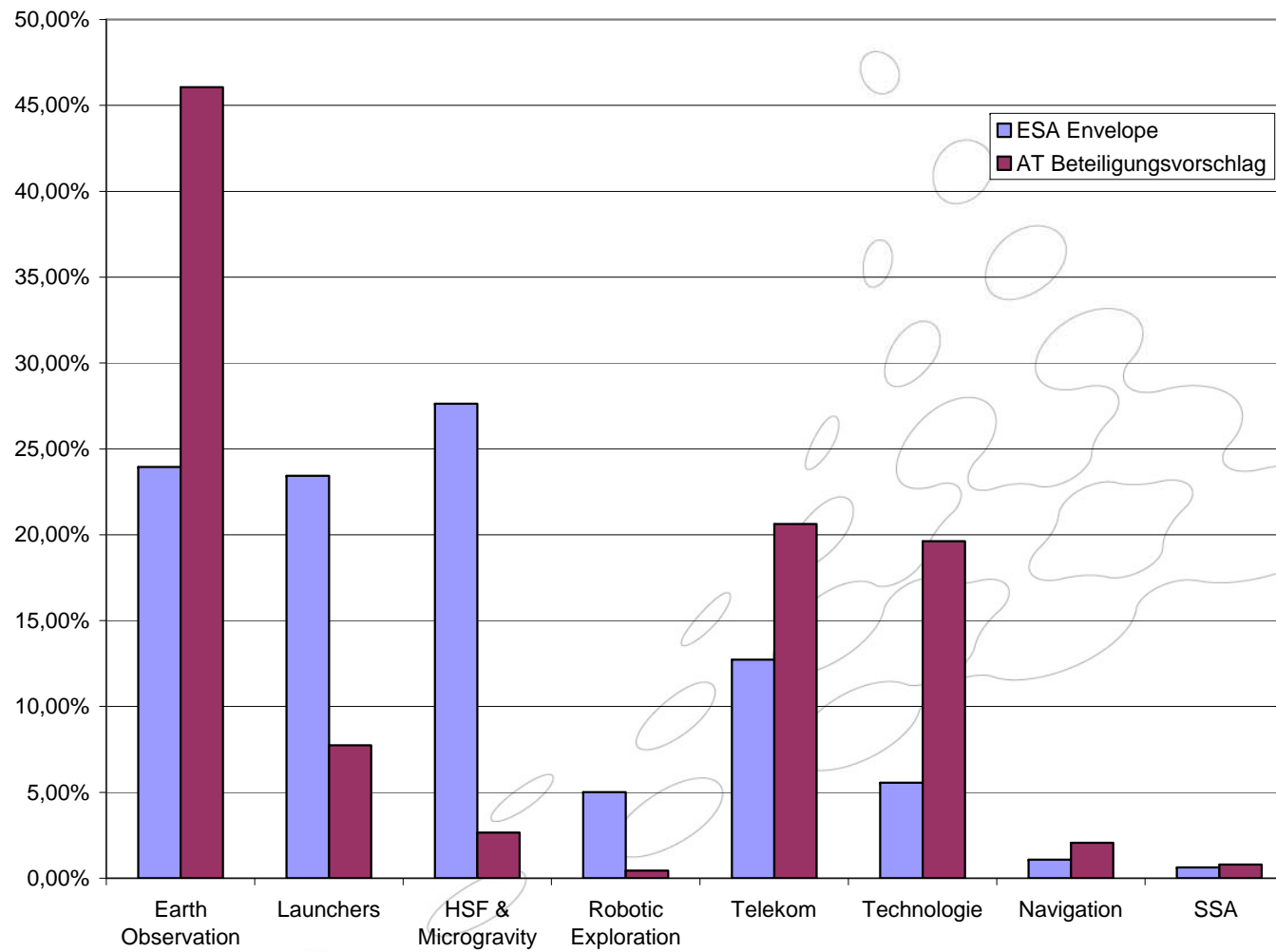
Referenz: ESA/AF(2009)7,REV.1,CORR.1



# Österreichs Beitragsprofil bei der ESA MK 2008

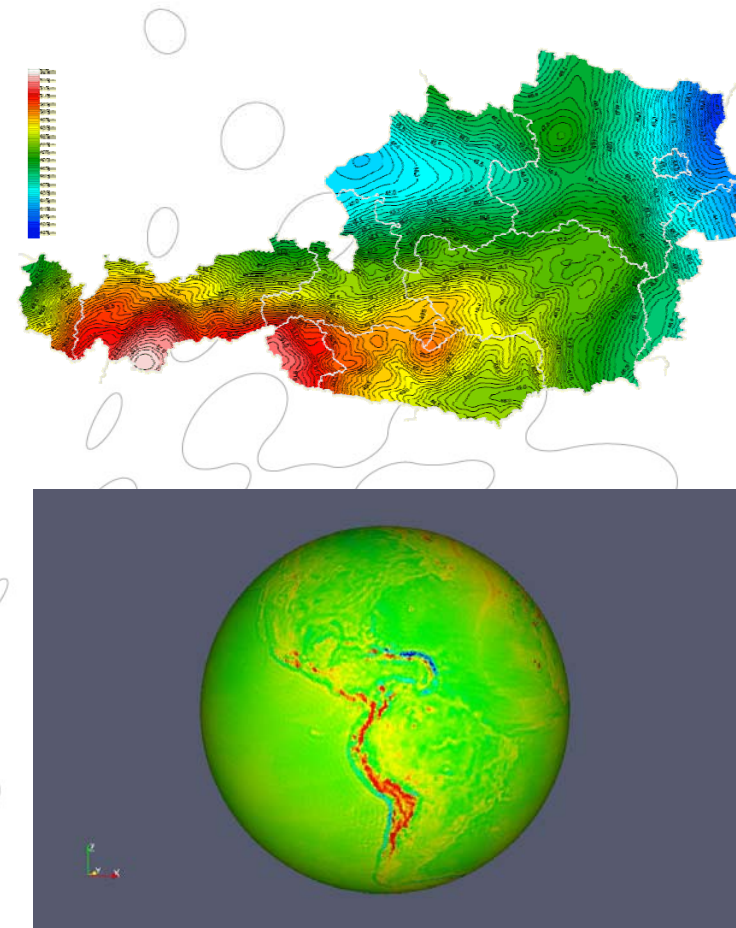


FFG



## Erdbeobachtung

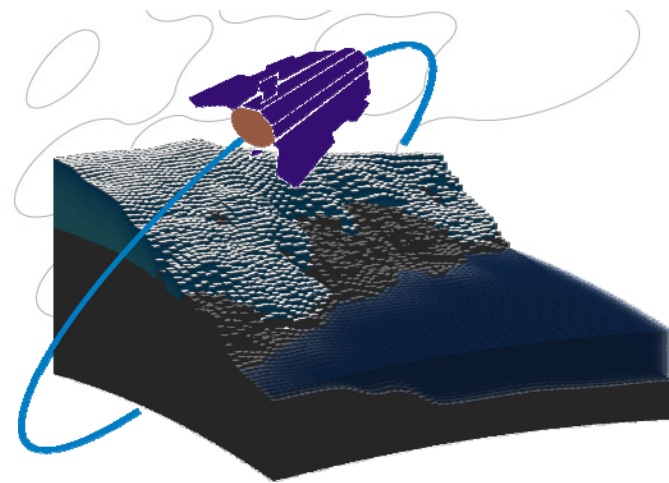
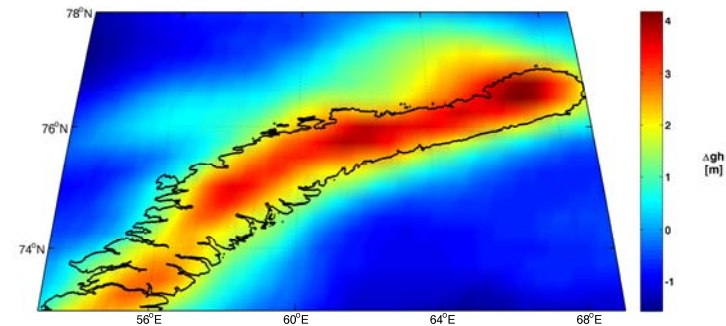
The main objective of the project GEOID+ is the computation of an improved geoid model for the Austrian territory, as a combined solution from terrestrial gravity field data (gravity anomalies, deflections of the vertical, direct “geoid” observations being the difference between geometrical heights obtained by high-precision GPS observations and orthometric heights by spirit levelling), and satellite-related data from the dedicated gravity field missions GRACE and GOCE, which shall stabilize the solution in the long to medium wavelength domain.





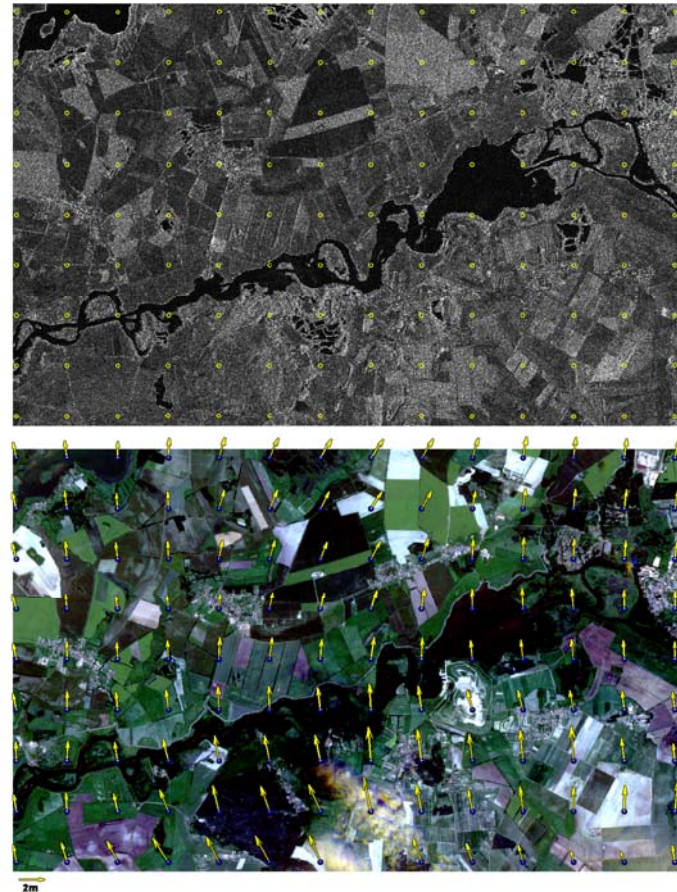
## Erdbeobachtung

In the frame of global warming, various methods for the monitoring of glaciers and ice caps are applied. In this context, the main objective of the project “Modelling snow-ice cover evolution and associated gravitational effects with GOCE constraints (ICEAGE)” was to set-up a processing environment serving to produce a suite of combined cryogravic models of the Eurasian Arctic Sector. Its snow and ice resources (SIR) were determined and mapped with respect to their present state on the one hand and to their fluctuations on the other hand.



## Erdbeobachtung

Within this project multi-seasonal, multi-sensor and multi-resolution (TripleM) image data sets are investigated with respect to their operational and scientific utilization for agricultural and hydrological applications. Information extraction is envisaged by simultaneous utilization of a broad variety of satellite image data. This is a rather ambitious intention, implying the development of new and innovative approaches to process and utilize TripleM image data sets. The main emphasis is put onto present and future European SAR systems as well as optical missions, like the German missions TerraSAR-X and RapidEye.



## Erdbeobachtung

PAT+ is an innovative software technology for online data access to the Pléiades Ortho Products covering large geographical areas.

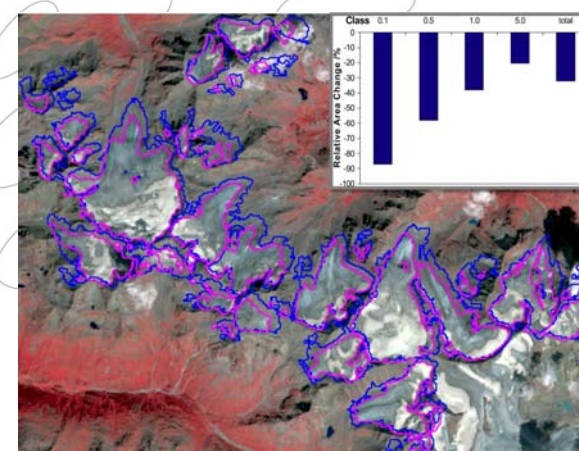
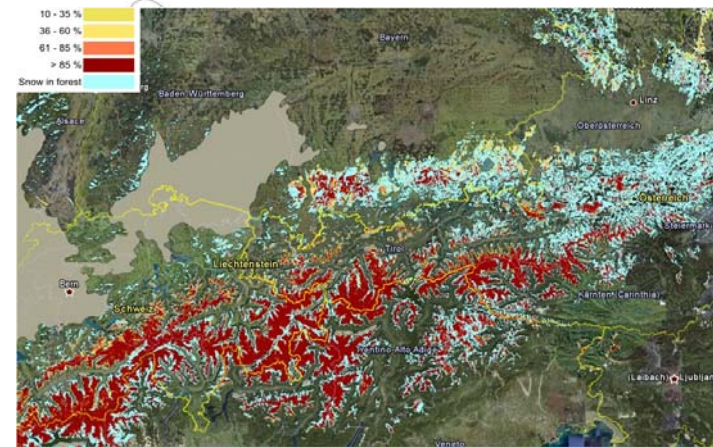
The available implementation has proven the technical feasibility of PAT+ and the envisaged online data access functions and is uniquely designed in that it combines features for:

- ingestion of TerraByte-volume ortho products;
- storage in a so-called Coverage Repository
- viewing on the Internet via Web browser providing optimum user experience;
- direct access delivery of PAT Products to dedicated client
- identity-centric user access management for implementation of data policy.



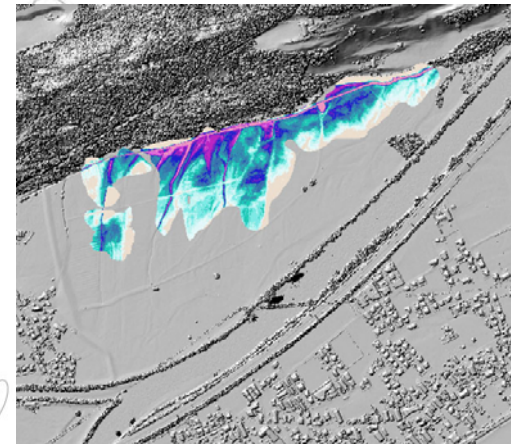
## GMES – Global Monitoring of Environment and Security

The ASaG project is aimed at the implementation of a satellite-based service for spatially detailed monitoring of snow cover and glaciers over extended areas. Snow cover and glaciers, storing large amounts of fresh water, respond sensitively to climate change. Accurate inventories and monitoring of these resources is important for water resources management, hydrology, and climate impact assessment. The service to be developed in ASaG aims to provide timely and reliable information on the extent and physical properties of snow cover and glaciers, as required for operational use, and shall be exploited in the context of GMES.



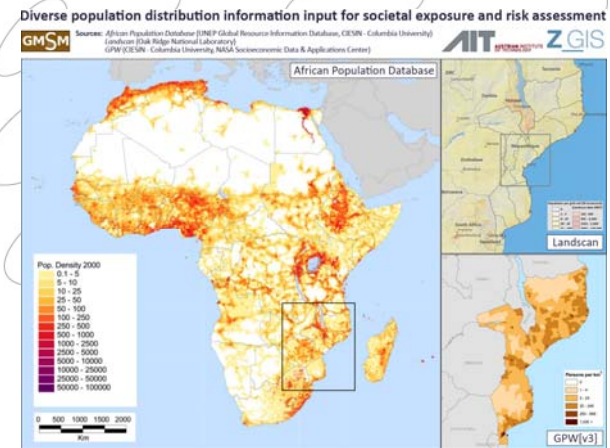
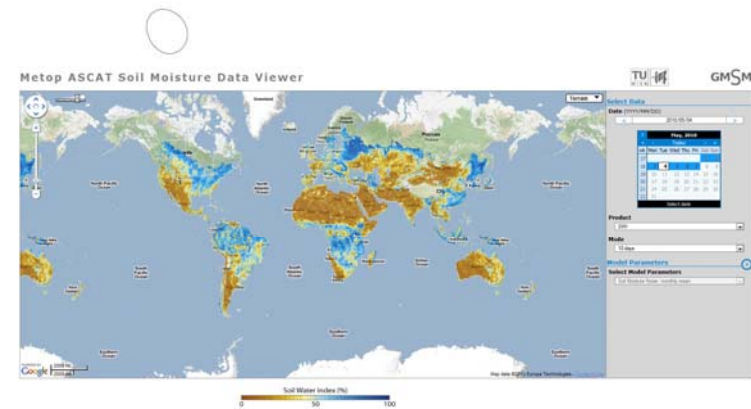
## GMES – Global Monitoring of Environment and Security

The dramatic increase of crises caused by natural hazards has created a strong demand for actual and specific geoinformation to enable a co-ordinated management of such events. In the frame of the project “EO-KDZ” (Earth Observation Krisendatenzentrum) it was intended to conceptually design and technically implement a regional and earth observation based centre for crisis data. This mobile centre is characterised by several components of geoinformation, which are collected, analysed and value added near or in the affected areas.



## GMES – Global Monitoring of Environment and Security

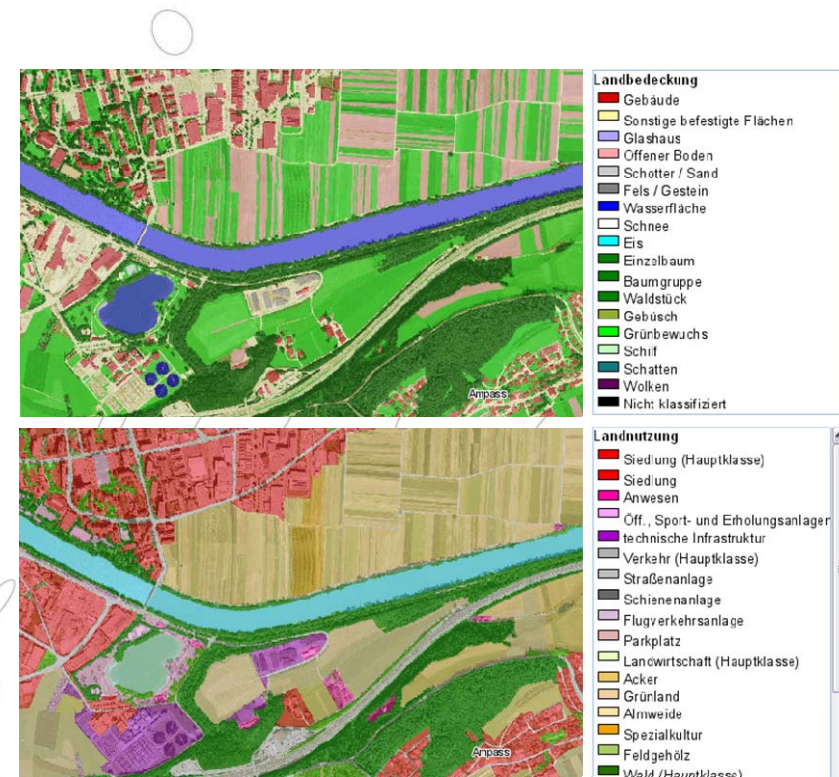
Soil moisture – the water stored in soil within reach of the plants – is a crucial parameter for a large number of applications. Near-real-time soil moisture information is, amongst others, important for weather forecasting, flood and drought monitoring, and civil protection. Long-term soil moisture time series are important for improving our understanding of impacts of global warming on water resources, carbon balance, ecology and epidemiology. The overall goal of the GSM project is to advance the use of soil moisture services based on METOP ASCAT and complementary satellite systems, most importantly SMOS and ENVISAT ASAR.





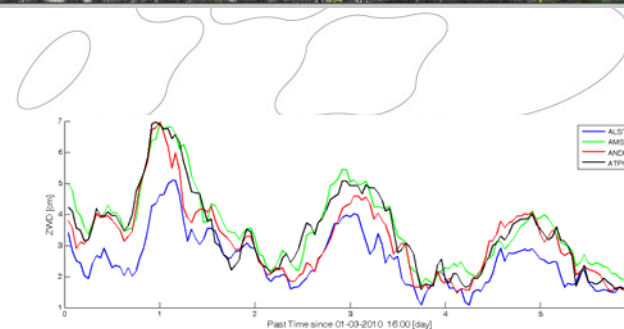
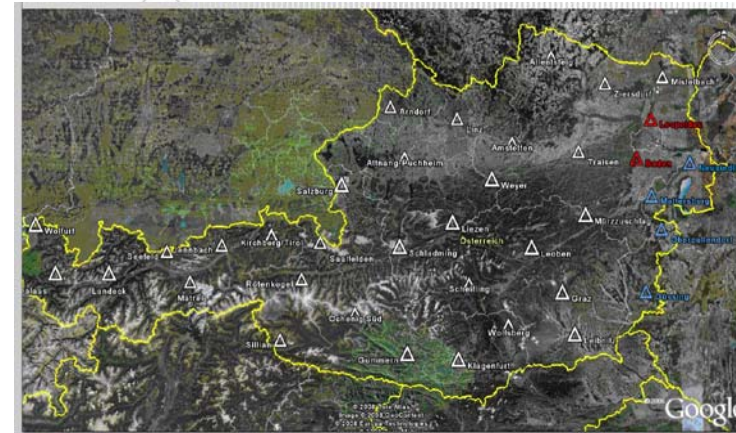
## GMES – Global Monitoring of Environment and Security

The objective of LISA is to achieve a consensus on a new Austrian land cover data base and demonstrate its benefits offering improved spatial and thematic content. A first prototype, which was specified by the users consisting of relevant experts from all regional governments as well as from federal authorities and institutions, was already put into effect for 33 testsites in Austria. Based on the scientifically validated results of the prototype the users currently adapt the specifications to achieve a technologically and economically feasible datamodel for national rollout.



## Navigation

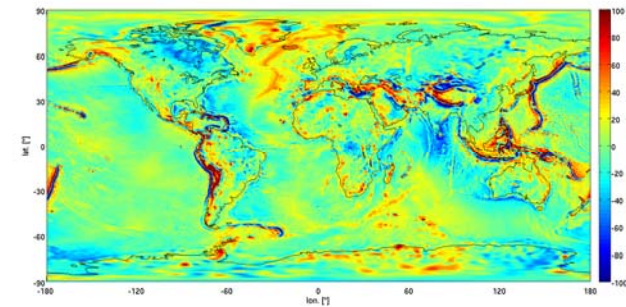
The microwave signals of the GNSS satellites (GPS, GLONASS and in future GALILEO) are time delayed when passing the atmosphere. Therefore the tropospheric delay (as part of the atmospheric delay) and subsequently the humidity distribution within the troposphere can be estimated from the microwave observations. The tropospheric delay is usually comprised of a well understood hydrostatic component and of the rapidly time varying wet component. The remaining wet component can be assimilated in numerical weather models. It has been proved that e.g. passing weather fronts can better be analysed by introduced GNSS derived tropospheric wet delays





## Navigation

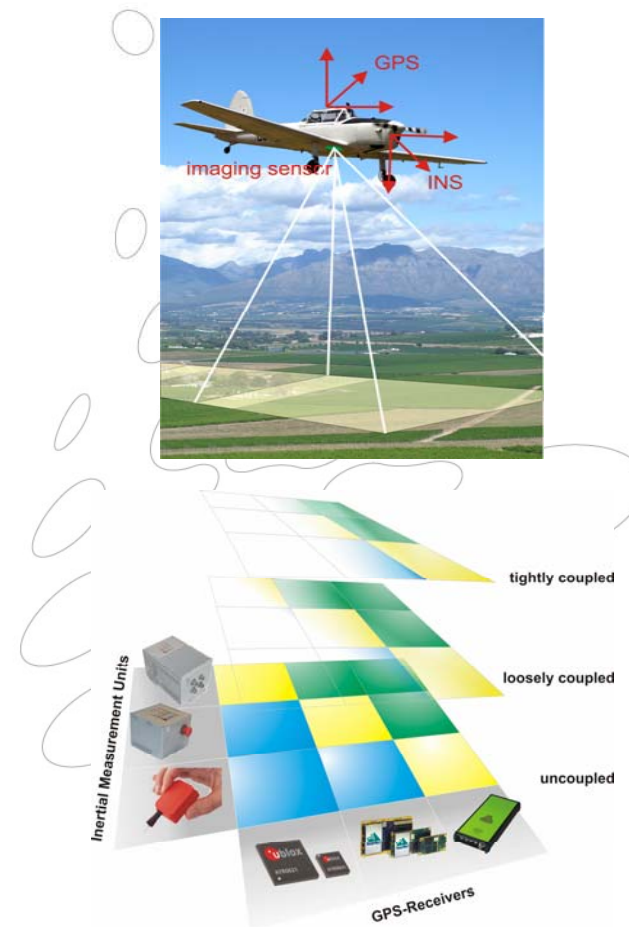
The main objective of the project GOCONAUT is the generation of high-resolution global gravity field models by combining data from the satellite gravity missions GOCE, GRACE and CHAMP with complementary gravity field information represented by terrestrial and air-borne data, satellite altimetry, and satellite laser ranging. These different data types are complementary with respect to their measurement principle, accuracy, spatial distribution and resolution, and spectral (error) characteristics. By means of data combination, benefit can be taken from their individual strengths and favourable features.





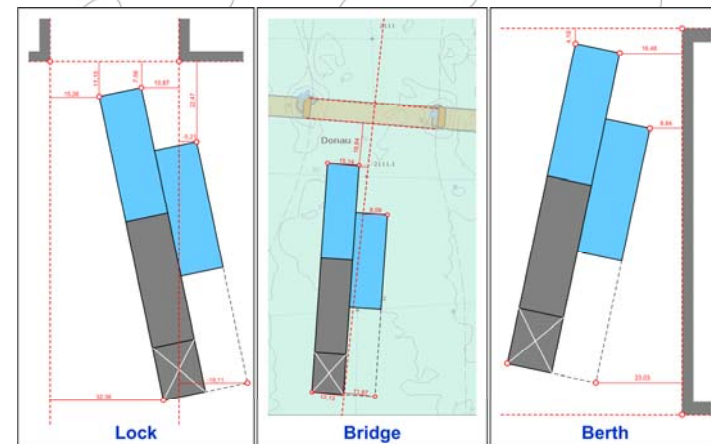
## Navigation

The main objective of the project VarloNav is a scientifically based and comprehensive investigation of the integration of Global Navigation Satellite Systems (GNSS) and inertial measurement systems (IMS). Regarding the high value of GNSS/IMS fusion within integrated navigation, the integration analysis is performed against the background of the challenging trajectory determination for a mobile exploration system (e.g., imaging sensors) and the subsequent direct georeferencing of the sensor and its output.



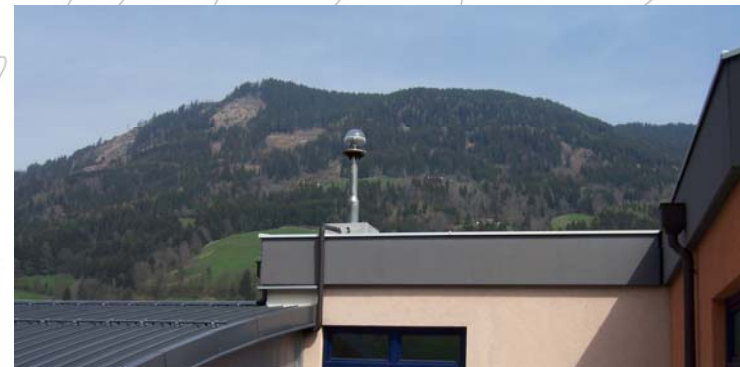
## Navigation

In NAVWAT, a system concept was developed which aims at supporting the ship crew of inland water vessels when navigating through narrow surroundings (in the vicinity of locks, bridges, harbours). The proposed concept utilizes modern GNSS and augmentation infrastructure to provide accurate position and velocity information as well as integrity information to the ship crew. This precise position information should be related to the information contained in the onboard Inland ENC (Electronic Navigational Chart)



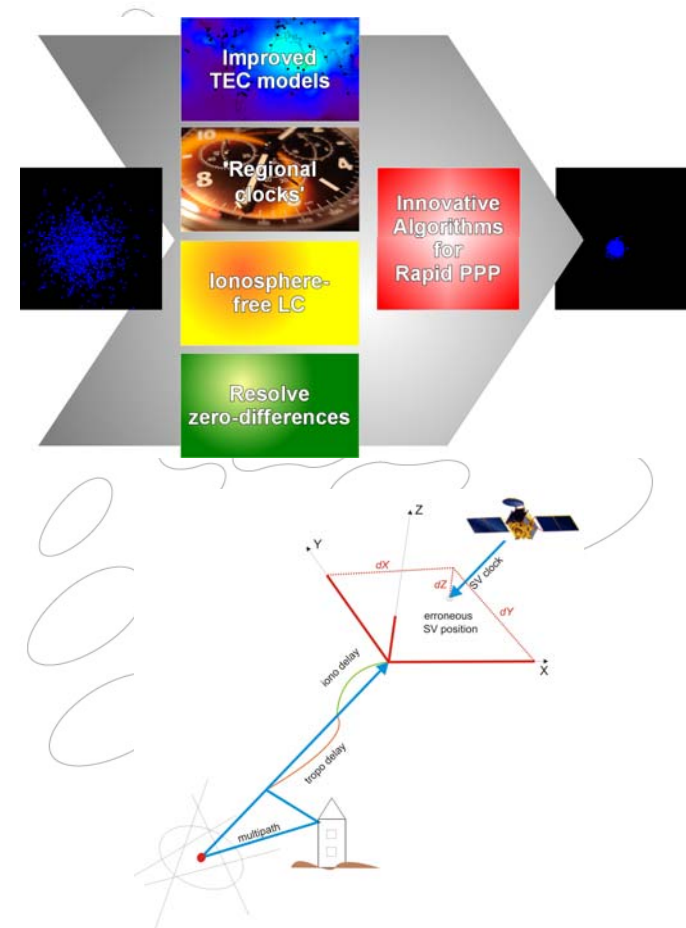
## Navigation

The driving force for a research project aiming at developing an Austrian EGNOS data server is the requirement for continuous GPS correction data stream with high integrity and continuous availability that facilitates national coverage. The topography of Austria obstructs the direct line of sight signals of the European Geostationary Navigation Overlay Service (EGNOS), therefore alternative transmission methods are considered. Furthermore, GPS/EGNOS signals do not provide the position accuracy required by various applications.



## Navigation

Is there a chance to achieve dm-accuracy in positioning, just by means of an isolated single-frequency GNSS receiver? Which further external data has this isolated receiver to be provided with and within what time frame does the position determination converge to the requested accuracy? These are the crucial questions of Precise Point Positioning (PPP). Using these external data-sources, inaccuracies in the orbit and clock information as well as atmospheric uncertainties can be circumvented. Furthermore, with a dual frequency receiver – eliminating ionospheric effects – centimeter to decimeter accuracy can be achieved.



## Outreach - The Summer School Alpbach



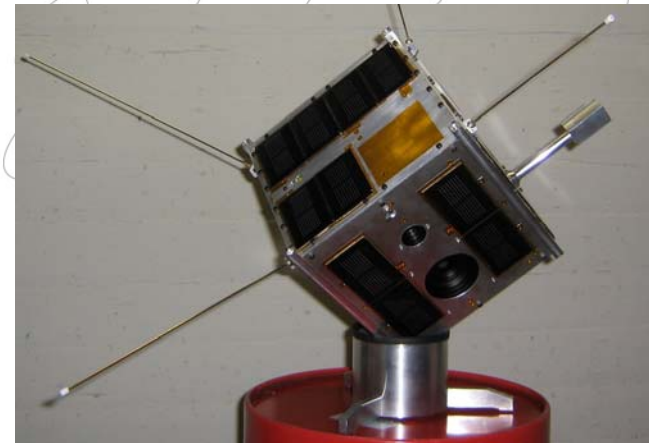
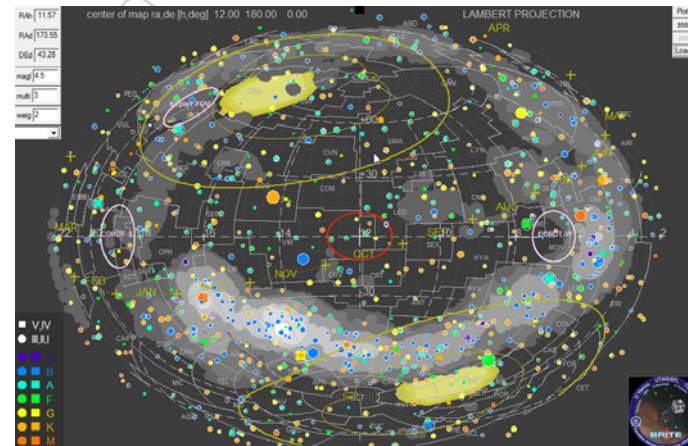
- 60 selected highly qualified young European space enthusiasts implement project studies
- 2 weeks of stimulating work & in-depth teaching on different topics of space science and technology
- 20 experts present existing climate change missions
- 60 students learn about the role of Earth observation satellites in climate monitoring and research
- 4 teams compete to design a space mission evaluated by a jury of experts



## Space Science

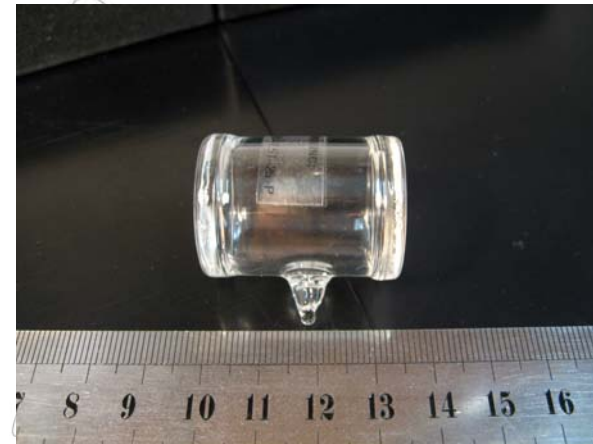
The BRITE (BRight Target Explorer) mission aims at the long-term investigation of the brightness variation of massive, luminous stars by differential photometry. The nanosatellite utilises recent improvements in three-axis stability control by pioneering Canadian space technology to the level of 1 arc-minute.

This is achieved by miniature momentum wheels and a combination of star tracker, sun sensors and a magnetometer as attitude sensors, opening up a totally new domain of miniature, low-cost spacecraft for astronomy and other high-precision space missions. The nanosatellite carries a small astronomical camera with a large field-of view as payload.



## Space Science

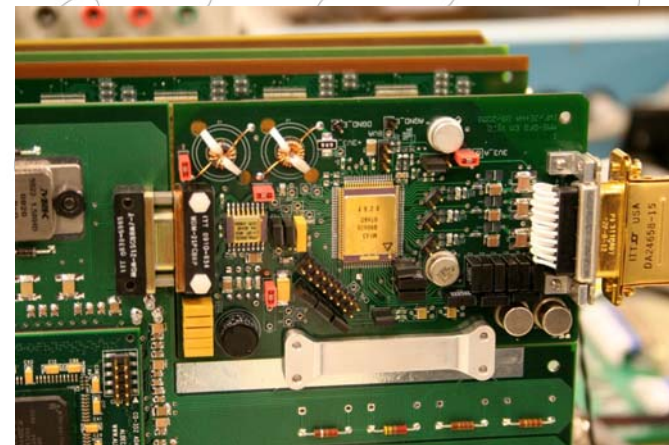
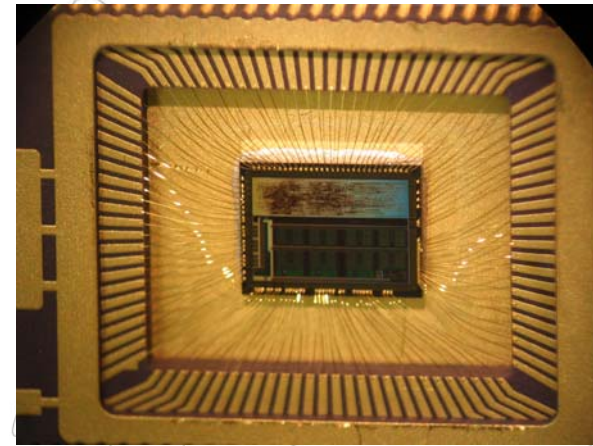
An absolute scalar magnetometer offers superior stability and offset-free measurements of the magnetic field magnitude. In space, it is used for improving the absolute accuracy of vector magnetometers, which also measure the direction of the magnetic field, but its absolute value only with limited precision. In several cases, full science return can only be achieved by a combination of vector and scalar magnetometers.





## Space Science

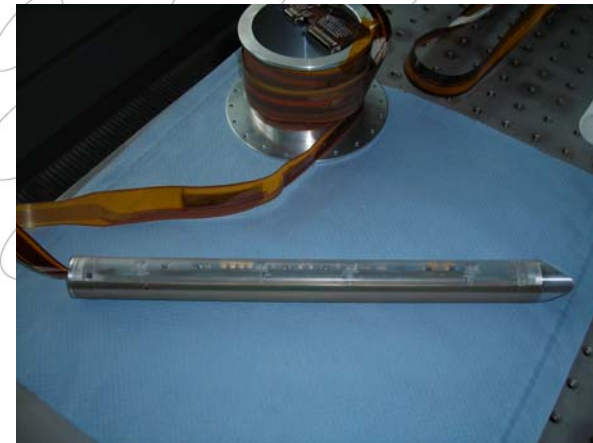
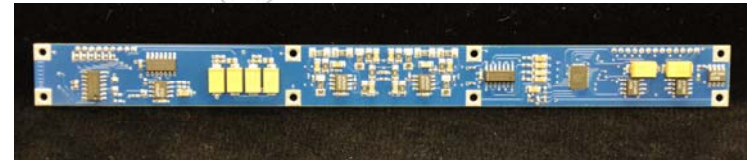
A prototype of an instrument front-end ASIC (Application Specific Integrated Circuit) for magnetic field sensors based on the fluxgate principle has been developed. It is called Magnetometer Front-end ASIC (MFA). With this mixed-signal (analog and digital) MFA in a 100-pin wide space qualified package, it is possible to reduce the required power for the read-out electronics by a factor of 10 and more as well as the area needed on a printed circuit board by a factor of 3-4 compared to magnetic field instruments, e.g., aboard Venus Express (ESA) and Themis (NASA).



## Space Science

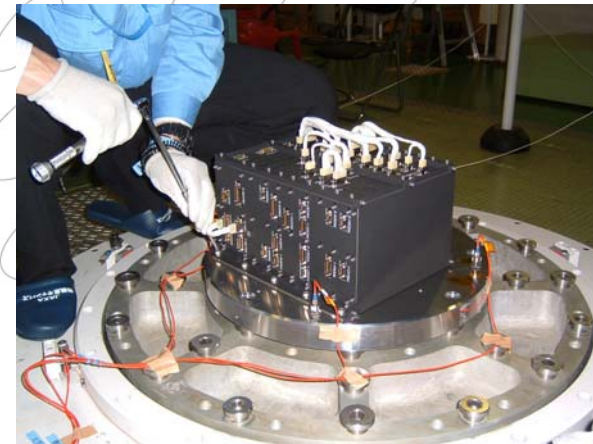
The investigation of the surface of other celestial objects, mostly of the planet Mars, currently is the major driver of robotic exploration. For this purpose instruments must be developed, which can autonomously perform field measurements and which fit in the tight resource envelope of a space mission.

The instrument was developed to investigate the thermal, mechanical and electrical properties of soil. The whole instrument is embedded in a mole penetrator, i.e. a mechanical instrument carrier resembling a nail with integrated hammering mechanism, which will deliver the sensors up to a depth of five meters into the Martian soil.



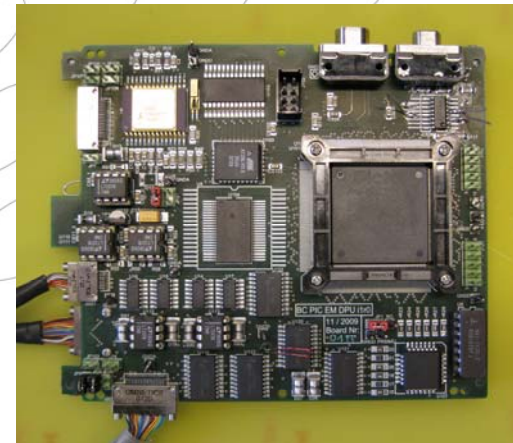
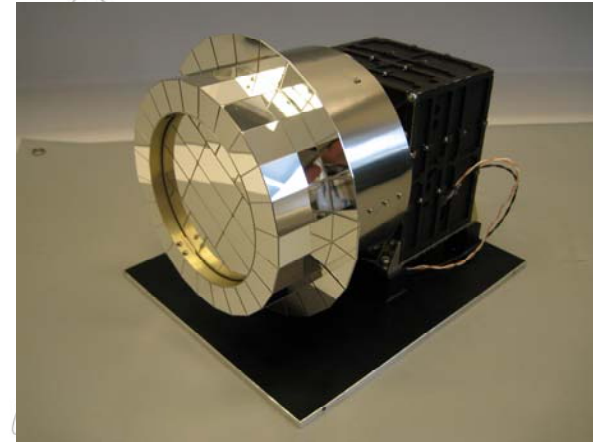
## Space Science

The satellite mission BepiColombo to Mercury, the planet closest to the Sun, for the first time is making two spacecraft, the Japanese Magnetospheric (MMO) and the European Planetary Orbiter (MPO), synchronously orbit around the innermost planet of our solar system. The BepiColombo composite spacecraft is setting off in August 2014 and will arrive at Mercury in 2020. A European-Japanese consortium of scientific institutions has been formed to carry out the magnetic field investigations aboard both spacecraft. The coordinated studies will focus on the planetary magnetic field as well as its dynamic interaction with the young and strong solar wind in this region.



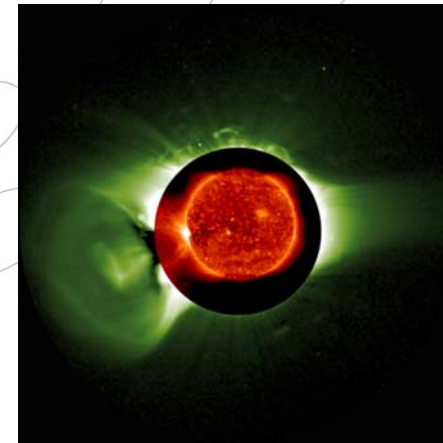
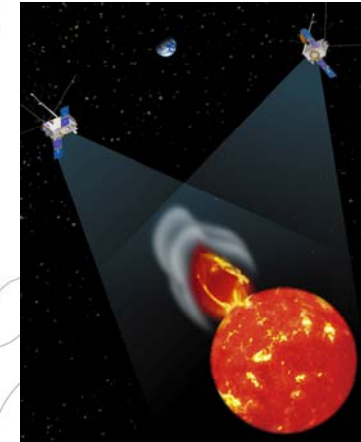
## Space Science

The mission BepiColombo to Mercury constitutes a milestone of space exploration, as this planet is very close to the Sun and equipped with a "Planetary Ion Camera" (PICAM) as a payload of the Mercury Planetary Orbiter. The instrument PICAM combines the features of an ion mass spectrometer with imaging capabilities for charged particles that will allow to study the chain of processes by which neutrals are ejected from the soil, eventually ionised and transported through the environment of Mercury. As a result one will better understand the formation of Mercury's tenuous atmosphere and the plasma within the cavity encompassed by its magnetic field.



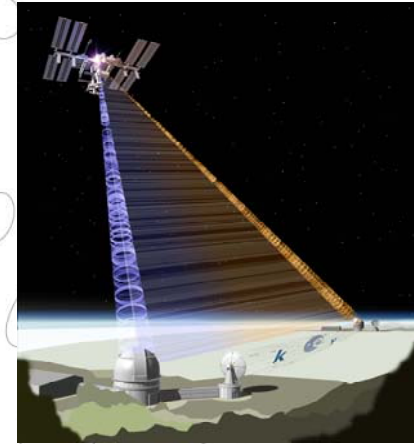
## Space Science

In SOLDYN we investigate three main topics: (1) the impulsive acceleration phase of CMEs, (2) the CME's relation to the associated flare's energy release, and (3) the CME source region characteristics and how they relate to the CME dynamics. These aspects provide essential ingredients for better understanding and modelling the physics of solar flares and CMEs.



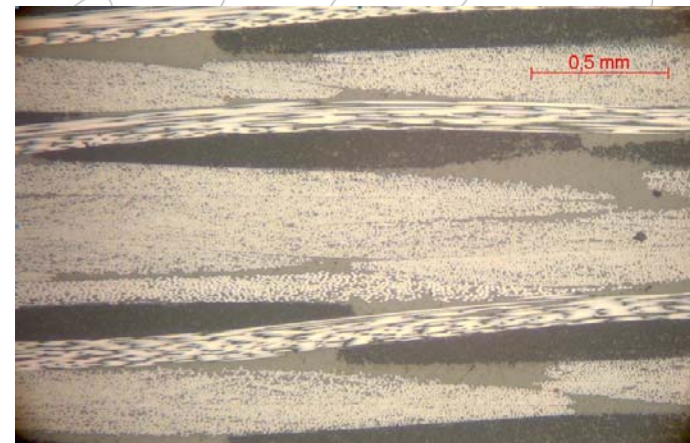
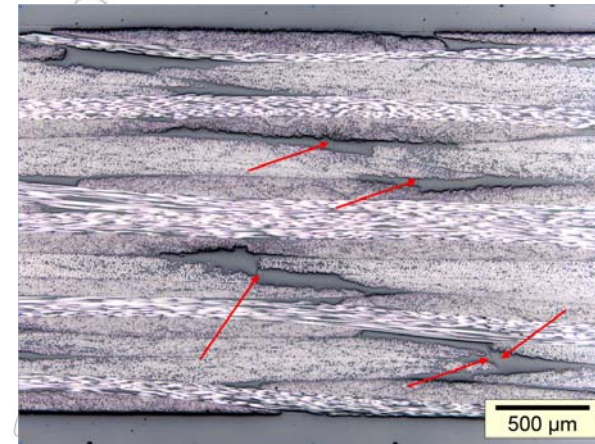
## Space Science

Quantum mechanics makes a number of predictions, that are in stark contrast to our intuition of the world around us. The most essential ingredient of these counterintuitive predictions is entanglement (correlations between particles), a property of groups of particles that exists independent of their spatial and temporal separation. Entanglement can be used to show that any 'intuitive' theory (where the properties of particles are well defined and interacting particles exchange some force) is not consistent with the world.



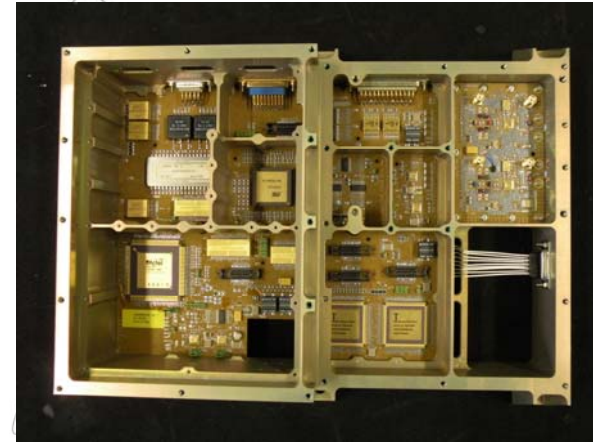
## Technologieentwicklungen

Cryogenic media storage and transportation systems for cryogenic fluids as used for the Ariane 5 upper/lower stage are made of stainless steel and aluminum components respectively. Composite components bear a potential for mass and weight savings among other advantages especially when exposed to extreme environmental conditions. They are used for tank vessels/systems, lines, ducts, and mechanical interfaces. The residual stresses due to manufacturing and the superimposed thermal stresses in the matrix have to be considered, as they can result in micro-cracking of the matrix.



## Technologieentwicklungen

The CORD activity aims at preserving Austrian competitiveness in the context of GPS receivers for future missions by performing the delta developments necessary to obtain a commodity GPS receiver, compliant with most of the future precise orbit determination (POD) receivers' requirements. An analysis of the available information on future missions indicates that the existing GPS receivers have several peculiarities compared to more standard requirements of typical GPS POD receivers. The main changes that have been identified are required for the telecommand/telemetry interface and for the satellite power bus interface.

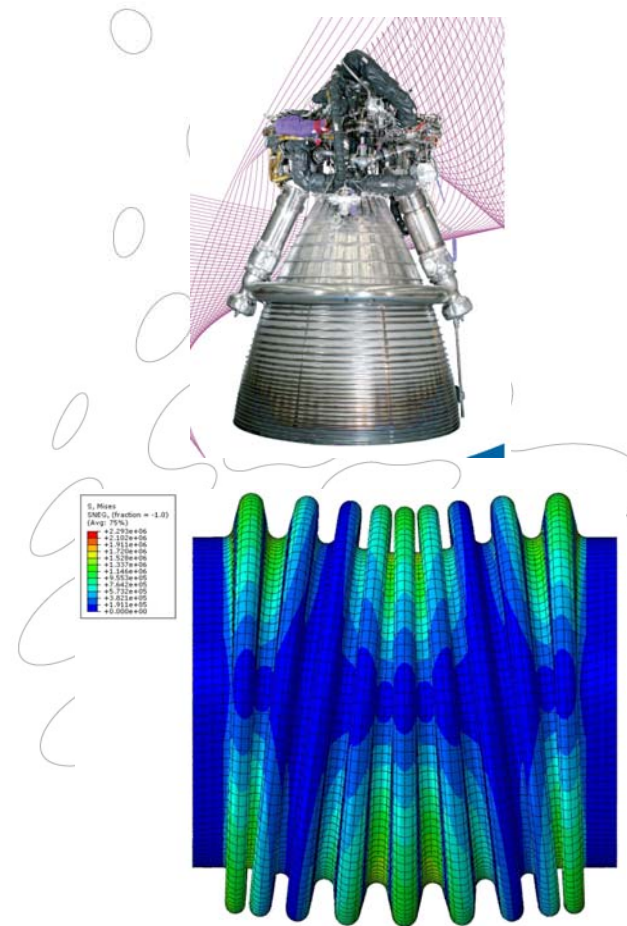






## Technologieentwicklungen

For launchers different engine concepts exist. Depending on these engine concepts, requirements for engine flexible elements are different. The various engine concepts will be analyzed regarding their impact on lines/expansion joints requirements. The most severe requirements will be selected. In a first step elementary studies will be performed. These studies deal with material, coating, life time and vibration problems. Based on these studies, a draft design of a high temperature expansion joint will be elaborated.



## Technologieentwicklungen

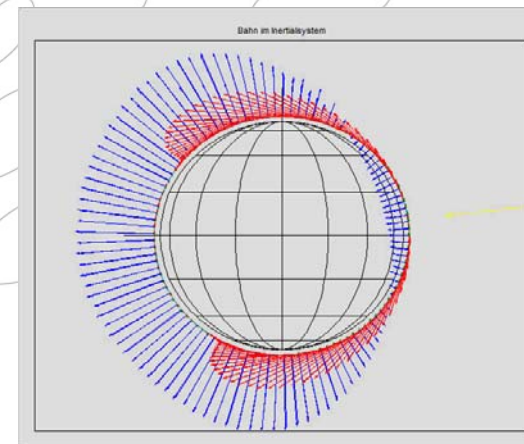
A nightmare scenario during assembling and testing a satellite is that it could be damaged due to malfunction or operational error and lead to mission delay and exploding costs. This risk especially occurs at the power subsystem such as solar array interfaces or onboard battery.

Due to rising power demand in spacecraft and related test equipment the protection unit was designated for an upgrade. It had to address several severe requirements at the same time: higher voltages, higher currents, more channels, more flexibility, smaller size (factor 10), and, of course, lower cost.



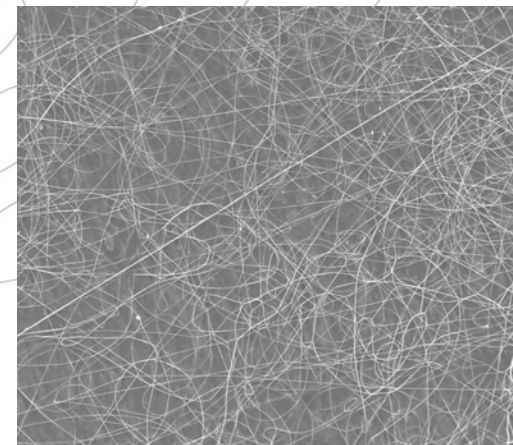
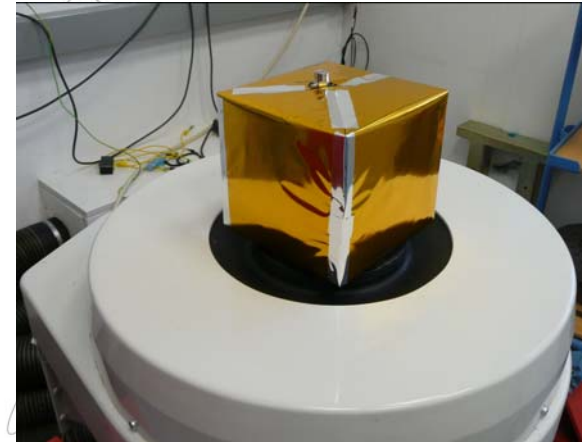
## Technologieentwicklungen

One key component of any GNSS receiver is the navigation solution, i.e. the determination of position, velocity and time. It can be observed that for the GPS receiver applications the real-time navigation solution has evolved from a basic feature, which allows for autonomous operation of a stand-alone instrument, to an element being crucial for the complete mission. The deployment of the respective performance requirements obviously have been so stringent that they go beyond classical navigation and provide precise orbit determination (POD) in real-time, already onboard the satellite.



## Technologieentwicklungen

Based on the multi-layer insulation technology for spacecraft, this technology transfer project, about non-flammable super-insulation focuses on the development of a novel, inert multi-layer thermal insulation, which satisfies the applicable requirements and standards for cryogenic vessels used for storage and transport of liquefied technical gases such as He, Ar, N<sub>2</sub> and O<sub>2</sub>, with respect to oxygen compatibility.



# Results





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