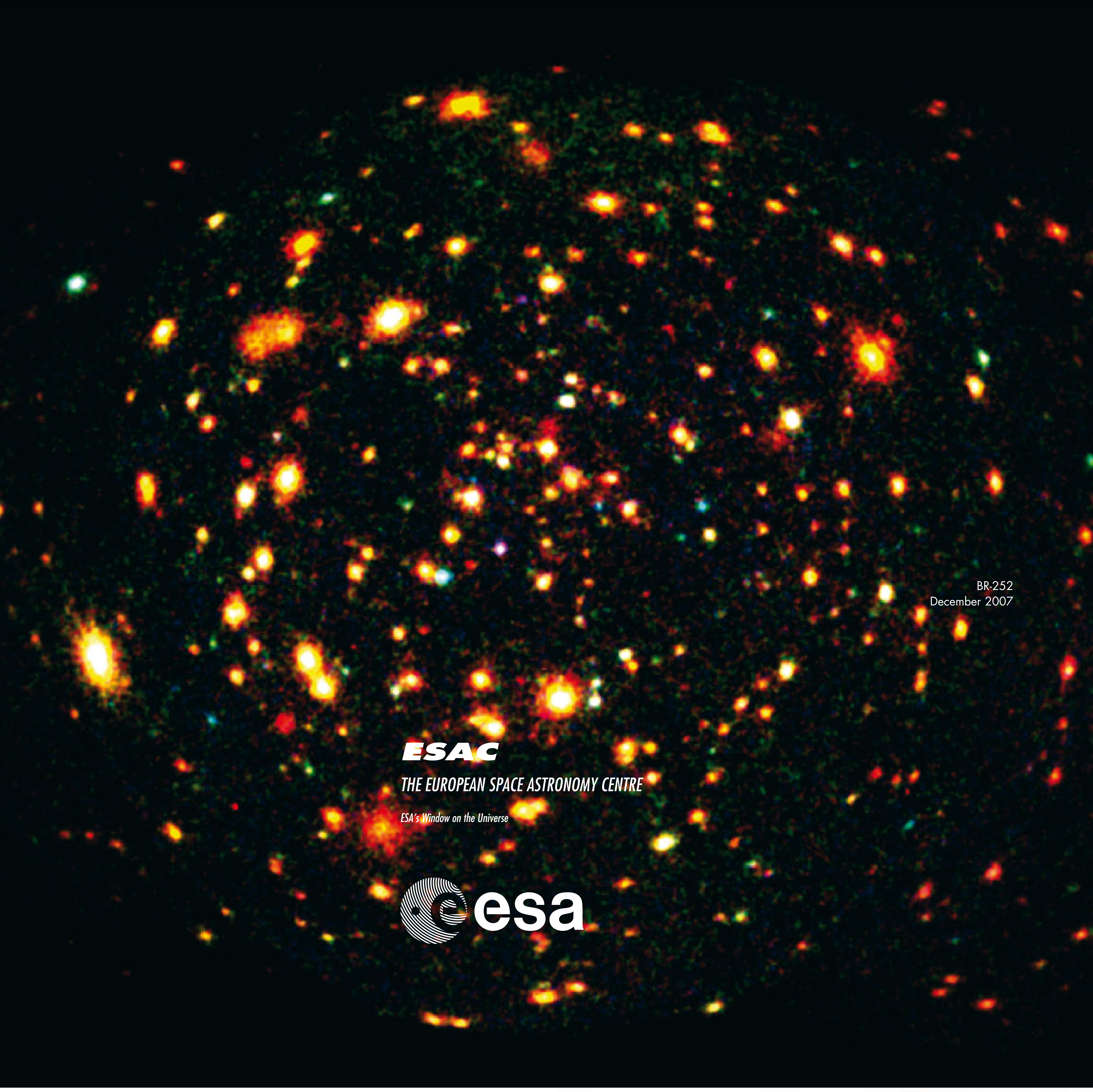

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December 2007

ESAC
THE EUROPEAN SPACE ASTRONOMY CENTRE
ESA's Window on the Universe

esa

Space telescopes are humankind's eyes in the heavens: from their superior observing positions high above the Earth's atmosphere, they provide us with astounding views of the Universe. ESAC, the European Space Astronomy Centre, is where some of those views are first studied – signals from black holes and distant galaxies, from neighbouring planets and even from planets far beyond the Solar System are beamed back to the Madrid countryside. ESAC is thereby the 'home' of ESA's space-telescope and planetary missions, the place from where science operations are conducted, and where all of the scientific data produced are archived and made accessible to the world.

ESAC is therefore one of ESA's centres of excellence for space science, but is also a focus for space technology, hosting one of ESA's two deep-space ground stations. These facilities allow ESA's engineers to gather data from distant missions in our own Solar System, from Mercury, Venus, Mars and beyond.

1

ESAC is located 30 km west of Madrid, in the Guadarrama Valley. The evergreen oaks and a neighbouring 15th century castle ruin make a spectacular backdrop for the high-tech vista of ESAC's large antennas and modern buildings.

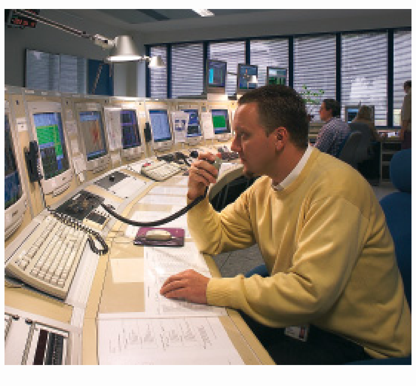
The Science

A CENTRE OF EXCELLENCE FOR SPACE SCIENCE

ESAC has been chosen as the site for the Science Operations Centres (SOCs) of ESA Science missions, for both astronomy and the Solar System. This means ESAC is rapidly evolving into a scientific hot-spot, a meeting point for top-level international space scientists working in different, but closely-related areas.

2

• ***The role of the SOCs:*** Once a space telescope has reached its operating orbit, or when a Solar System mission is on its way to its faraway destination, then it is the scientists' task to use it in the best way possible. For instance, if the telescope is an observatory-type mission, then astronomers from all over the world can submit observing proposals, in which they ask for the instruments to be pointed to study particular objects. Once such proposals have been evaluated and selected, the 'agenda' for the telescope's operation needs to be carefully designed. This is just one of the tasks usually performed at the SOCs for an ESA mission. They are also often responsible for the calibration of the instruments on board the spacecraft, and for helping the scientific community to process and analyse the data obtained by the instruments being flown.



• ***The SOCs at ESAC:*** ESAC currently hosts the SOCs for the following missions:

* XMM-Newton, launched in 1999. The most sensitive X-ray telescope ever built, used to study violent phenomena, such as active black holes.
* Integral, launched in 2002. A gamma-ray space telescope to detect the most energetic events in the cosmos, such as gamma-ray bursts.
* Mars Express, launched in 2003. Studying the 'Red Planet' in great detail.
* Rosetta, launched in 2004. It will reach Comet 67P/Churyumov-Gerasimenko in 2014.
* Venus Express, launched in 2005. Analysing the Venusian atmosphere with unprecedented sensitivity.
* Herschel, to be launched in 2008. An observatory at infrared and sub-millimetre wavelengths to observe the first stars and galaxies ever formed. It will have the largest telescope mirror launched to date.
* Planck, to be launched together with Herschel. It will study the origin and evolution of the Universe.
* LISA Pathfinder, to be launched in 2010. It will prove technologies for the LISA mission.
* Gaia, to be launched in 2011. It will produce a three-dimensional map of the Milky Way.

ESAC will soon welcome the SOC of BepiColombo, a mission to Mercury to be launched in 2013.

ESAC also plays a role in missions conducted in collaboration with other space agencies, such as AKARI, JAXA's infrared sky surveyor, where ESAC provides precise attitude information for the mission's catalogues and user support to the European astronomers who have observing opportunities. In the future ESAC will contribute to the NASA-led James Webb Space Telescope, the successor to the Hubble Space Telescope. The ESAC site also hosts the Spanish Laboratory for Space Astrophysics and Fundamental Physics (LAEFF), an innovative research facility aimed mainly at encouraging young Spanish scientists to enter the fields of astrophysics and fundamental physics.

The Archives

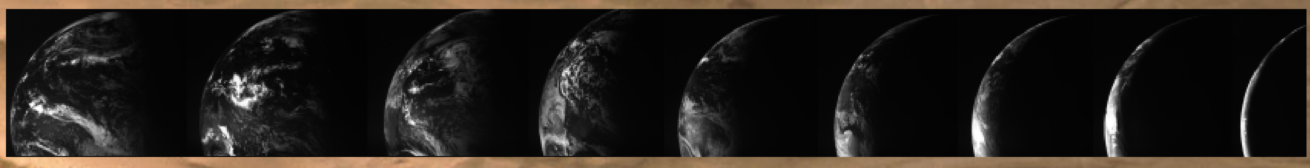
A SCIENTIFIC TREASURE TROVE

The vast amounts of scientific data obtained during a Space Science mission have a much longer lifetime than the satellite mission itself. The data are archived and made freely accessible on-line to the world scientific community, and these archives are frequently a mine of unexpected discoveries. They allow researchers to study, for instance, the evolution of a certain celestial object with time, or its appearance at different wavelengths as observed by different telescopes.

*** Science archives at ESAC:** The archives for all of ESA's astronomy and Solar System missions are kept at ESAC so researchers have a single 'entry point' for accessing the wealth of scientific data. Data from the ISO, XMM-Newton and Integral telescope missions and from the interplanetary spacecraft Mars Express, SMART-1 (the Moon), Rosetta (Comet 67P/Churyumov-Gerasimenko), Huygens (Titan), Venus Express and Giotto (Comet Halley) are already available in ESAC's state-of-the-art archival system, and are regularly consulted and retrieved by more than 3000 registered users. Data from many more missions will soon be added, in particular Herschel, Planck and SOHO.

A Powerful Virtual Observatory

The World Wide Web has no borders, so why not link all of the existing astronomical archives? That is the goal of the international Virtual Observatory (VO) programme, to which the ESAC archives are contributing. As a data provider and an active partner in these activities, ESAC is becoming the VO node for European space astronomy. Soon, scientists will be able to transparently access all astronomical data from their desktops, in much the same way as they currently access documents on the internet.



The Operations

COMMUNICATING WITH SATELLITES

Satellites stay in contact with the Earth by means of a ground-station network. Engineers send commands to correct their trajectories, manoeuvre them into different orbits, and operate their instruments. The satellite transmits back to Earth not only the scientific data that it is gathering, but also the 'housekeeping' information needed by the operators to check the satellite's performance.

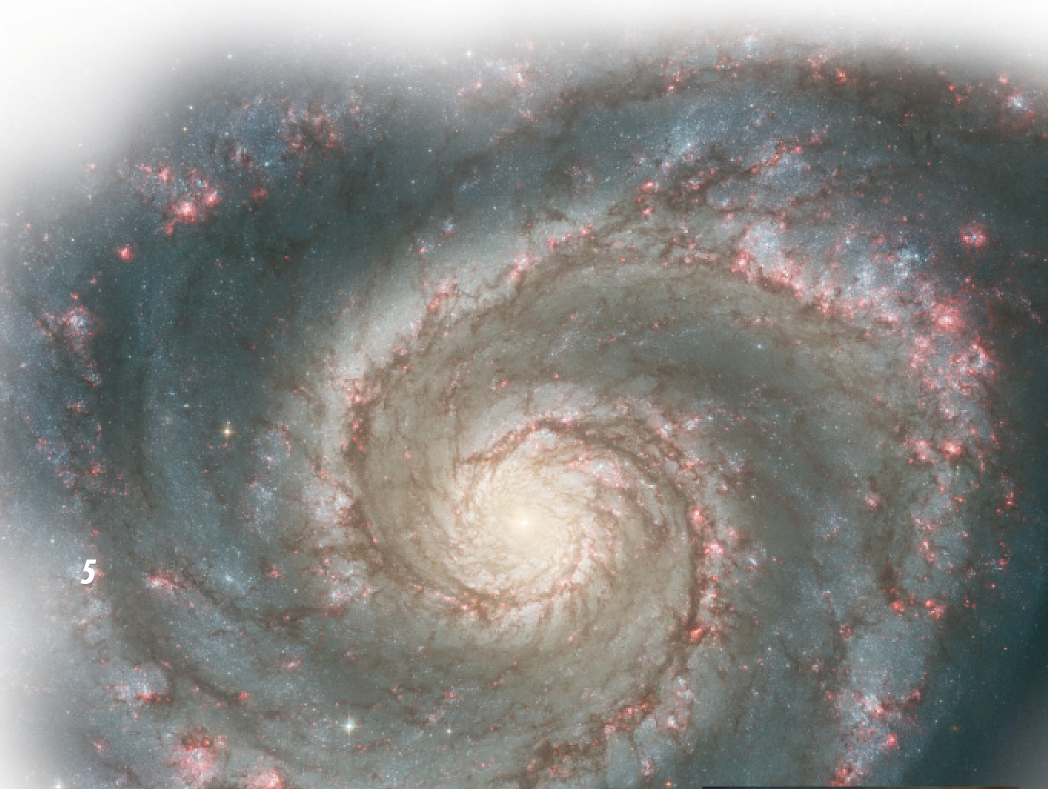
The scientific data from all astronomy and Solar System ESA missions whose Science Operations Centres (SOCs) are housed at ESAC arrive there from the Agency's European Space Operations Centre (ESOC) in Darmstadt, near Frankfurt.

For these purposes, ESAC has a number of antennas with modern electronic telemetry, telecommand and ranging equipment that allows commands to be sent to control the satellites and their payloads, as well as the scientific data to be received on the ground. The ESAC antennas currently support Double Star, two Chinese satellites that complement ESA's Cluster four-satellite flotilla in studying Earth's magnetic field. Occasionally, they also support Cluster, together with Integral, XMM-Newton; also two of ESA's Earth-observation satellites, Envisat and ERS-2, as well as the International Space Station.

The Cebreros Deep-Space Antenna

ESA's next generation of astronomy and Solar System missions are highly ambitious. Designed to open up new frontiers in space exploration, many of them will be placed very far away in space, not even orbiting Earth. To communicate with these deep-space missions, ESA is building-up a new network of deep-space antennas.

The powerful new 35-metre antenna at Cebreros in Ávila, Spain, is currently one of two ESA deep-space ground stations, the other being at New Norcia in Australia. Cebreros's first task has been to support the Venus Express mission – the first ESA mission to our nearest neighbouring planet – from November 2005. Other interplanetary missions will follow, including BepiColombo, as well as missions orbiting the second Lagrangian point – a point beyond the Moon, 1.5 million kilometres from Earth – such as Herschel, Planck and Gaia.

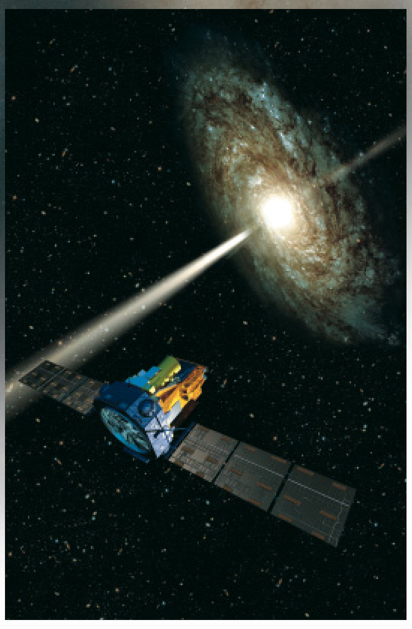


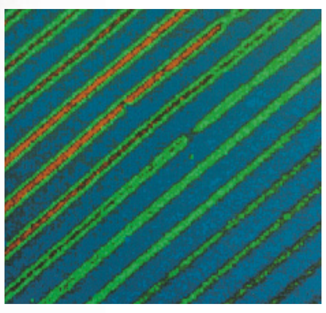
History

MORE THAN TWO DECADES OF REACHING OUT INTO SPACE

ESAC was founded in 2004 on the Villafranca site, which officially opened in 1978 as VILSPA (from VILlafranca SPAin), one of ESA's original satellite tracking stations. VILSPA, operated remotely from the European Space Operations Centre (ESOC) in Darmstadt, Germany, has been responsible for providing telemetry, tracking and command support to ESA as well as non-ESA satellites. The ESA satellites have included: the International Ultraviolet Explorer (IUE), Marecs, the first- and second-generation Meteosats, Hipparcos, ERS-1 and 2, the Infrared Space Observatory (ISO) and SMART-1, ESA's mission to the Moon.

The station has also hosted the Science Operations Centres (SOC) of IUE – which operated for more than 17 years and became the most prolific astronomical satellite yet launched – and ISO, the world's first true orbiting infrared observatory, which made more than 30 000 scientific observations.





The Future

PLANS FOR THE FUTURE BEYOND SPACE SCIENCE

In addition to its expanding role in astronomy and planetary sciences, ESAC has ambitious plans for future activities in additional areas. ESA's Exploration initiative for the next decade, for example, will profit from the activities and facilities managed by ESAC.

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Another field with a great growing potential is surveillance in the complete region of near-Earth space. Recent studies have concluded that surveillance of the Low Earth Orbit (LEO) region, and up to and including the geostationary ring, could be carried out by radar facilities located in southern Europe, plus optical telescopes. With the advantages provided by its geographical location, ESAC has the potential to be a fundamental element in any future space-surveillance network.

ESAC will also soon be more involved in Earth-observation activities. The Spanish national centre for ESA's Soil Moisture and Ocean Salinity (SMOS) mission will be located at ESAC. To be launched in 2008, SMOS has been designed to observe soil moisture over the Earth's land masses and salinity over its oceans, which are exactly the kinds of data urgently needed by experts studying the global climate system.

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