esa BR-90

esa
european space agency

This booklet was produced on the occasion of the 25th anniversary of the European Space Operations Centre (ESOC). Many thanks to all those who contributed pictures and texts.

Compiled by: *Jocelyne Landeau-Constantin*
Oscar Bischof
Pauline Bolle-Mead
Siegmar Pallaschke
Inge Schlicker
Yves Trehin

Edited by: *Norman Longdon*

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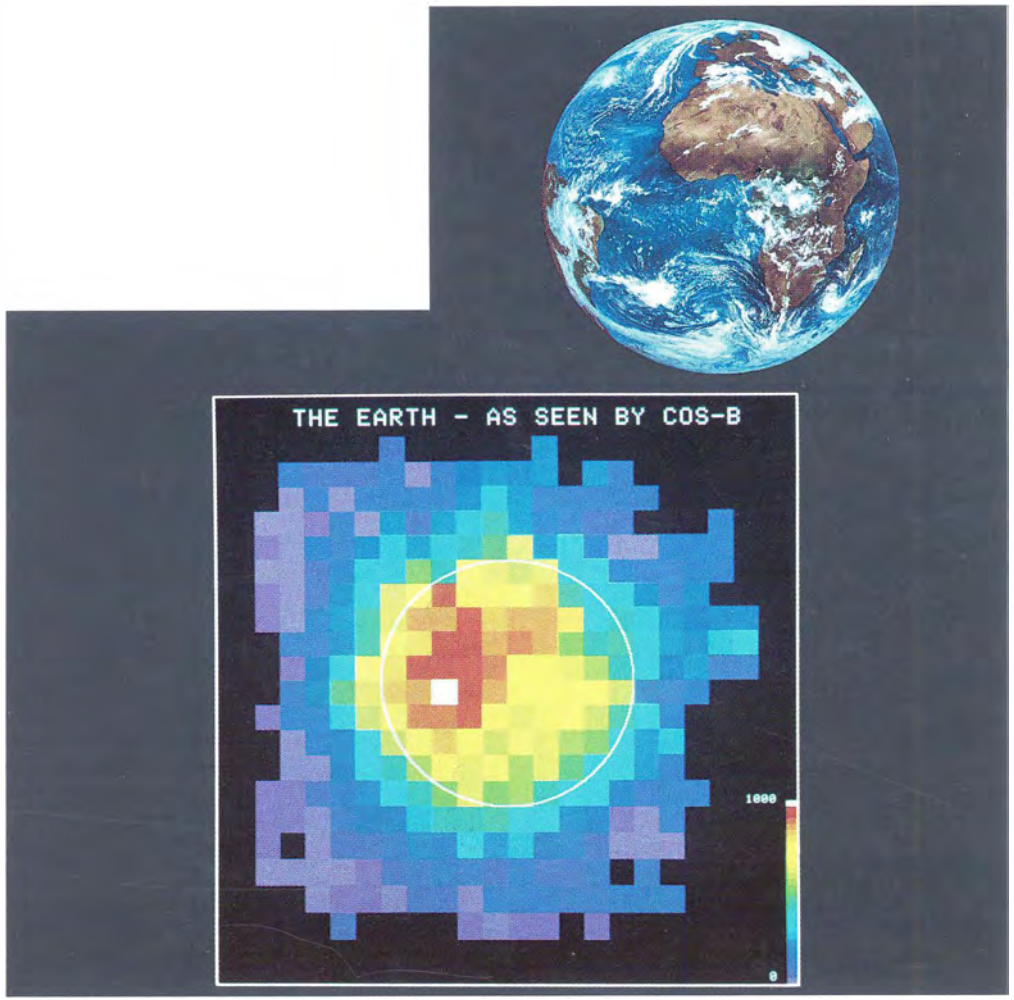
Thou dost preserve the satellites from wrong,
And the most ancient spacecraft,
through Thee, are fresh and strong
Thus (almost) wrote Wordsworth in his *Ode to Duty*

Praised be the fathomless Universe,
For life and joy, and for objects and knowledge curious.
Walt Whitman



Foreword

by Félix Garcia-Castañer

ESA Director of Operations

When Dr. Gerhard Stoltenberg, Federal Minister of Science, inaugurated the European Space Operations Centre (ESOC) in 1967 few people could have imagined that the day would come when this centre would be looking after fifteen satellites simultaneously, and managing a network of nine ground stations.

The European Space Agency has a variety of programmes, and this has made the task of ESOC most exciting. We have had, and continue to have scientific missions that change radically our understanding of the Universe, telecommunications from an experimental phase to operational services, European meteorological missions and global weather services, remote sensing of the Earth's environment, and material and life science experiments in space.

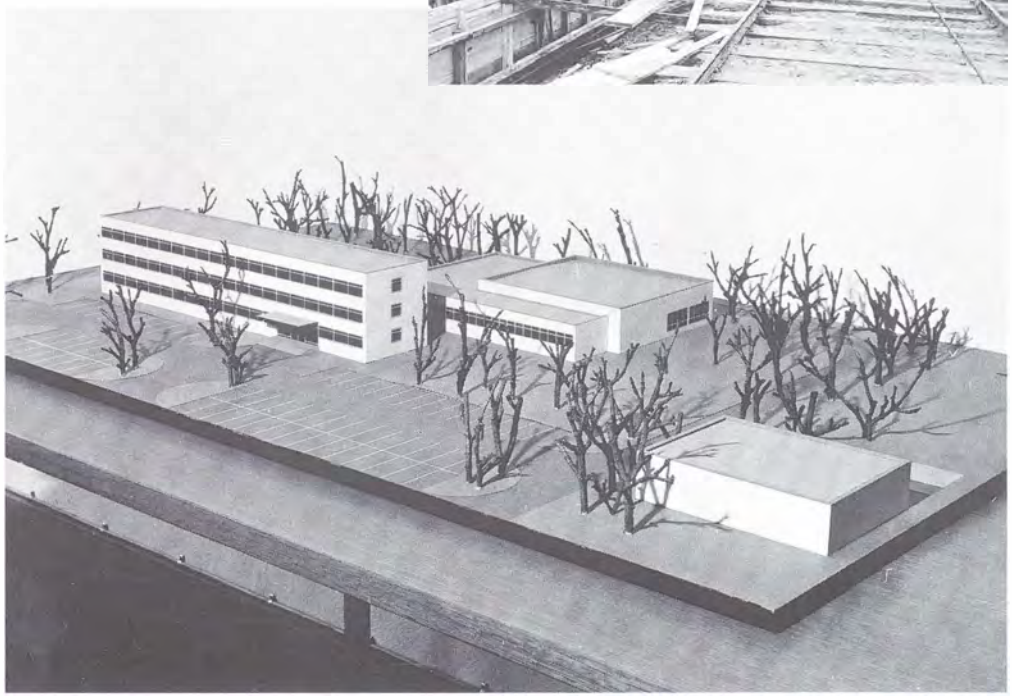
ESOC's contribution to the success of ESA has been the development of a unique operational and engineering competence that has kept pace with the complexity of the spacecraft and the increasing demands of the user communities.

One factor is behind all the more than 30 satellites that have been supported by ESOC: the people. It is their dedication and enthusiasm, allied to competence and team spirit that has stood out as the hallmark of ESOC's work throughout the 25 years. It is the same driving force that will see ESOC grow in public esteem when supporting the coming generation of ESA missions. It is therefore to the men and women of the European Space Operations Directorate that I dedicate this book.

Pioneering times (1)

In 1963, the European Space Research Organisation (ESRO) opened the European Space Data Centre (ESDAC) in Darmstadt at Das Deutsche Rechenzentrum. ESDAC was charged with the processing and analysis of the scientific data collected by the sounding rockets and satellites.

Then with the prospect of new satellites to be launched for ESRO an operations centre had to be founded. A new ESDAC building was inaugurated in 1967. The European Space Operations Centre (ESOC) was born.



Pioneering times (2)

Darmstadt becomes the Houston of Europe heralded an article in the Darmstaedter Echo on inauguration day. ESOC has taken on the role of space control in Europe: a role it still proudly plays.

On 8 September 1967 Dr Gerhard Stoltenberg, then Federal Ministerof Scientific Research, in a speech on Space Research in Germany and Europe, stressed that despite problems with Europa I the further development of the European launcher was unavoidable and that European space activities were necessary for economic and political reasons.

At that time the new European Space Operations Centre (ESOC) had a staff of 95 (53 from the ESDAC and 42 transferred from the ESTEC, the ESRO establishment in the Netherlands) led by Stig Comet, who as Director of ESDAC had contributed greatly to the development of a significant operations centre.

Managing ESOC

Operating satellites requires good preparation of men and equipment. The task has expanded considerably over the years, calling for constant appraisal, and when necessary reorganisation to increase our efficiency in the control of satellites and the processing of data. To achieve the best possible outcome has been the concern of all ESOC Directors.

Directors of ESDAC & ESOC

ESDAC
Dr Stig Comet (S) 1963-1967

ESOC
Umberto Montalenti (I), 1967-1973
Giani Formica (I), 1973-1979
Reinhold Steiner (CH), 1979-1984
Kurt Heftman (A), 1984-1991
Félix Garcia-Castañer (E), 1991 —

ESOC has evolved from two departments, (ESDAC and the Control Centre) to today's organisation, by which ESOC carries out its tasks through the Mission Operations, the ESA Computer and Networks Operations, the Flight Control Systems Department, the Stations and Communications Engineering, the Administration Departments and the Management Support Office.

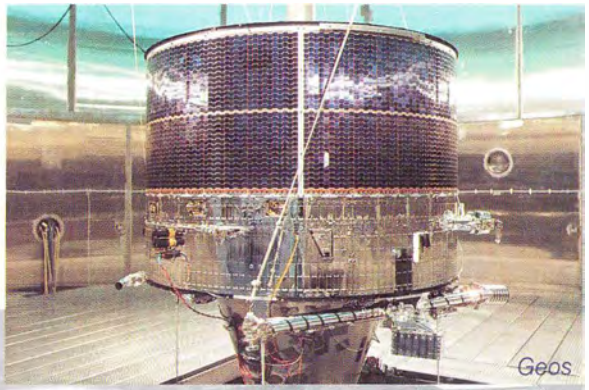
Sleepless Control

More than 30 satellites, for Eutelsat, Eumetsat and Inmarsat as well as for ESA, have been controlled and watched over day and night by ESOC. Support or even full operational control has also been provided for 14 satellites built for national agencies and administrations.

Since the first mission, ESRO-2 (IRIS) on 17 May 1968 the record reads:
— seven satellites in close Earth orbit
— six satellites in geosynchronous or highly eccentric orbits
— seventeen satellites in geostationary orbit
— two on interplanetary flights.

ESOC has been responsible for a wide range of satellites:
— sixteen scientific satellites
— eight telecommunications
— five meteorological
— one remote sensing
— one retrievable carrier

In 1992 ESOC still operates, directly at Darmstadt or from its network of ground stations, sixteen satellites.


Geos

Looking outwards — scientific satellites

The generations of scientific satellites have been designed with two major objectives - to understand better the solar system and to gain knowledge of the Universe beyond the solar system. Freed from the Earth's atmosphere they have changed scientific knowledge out of all recognition.

solar system missions

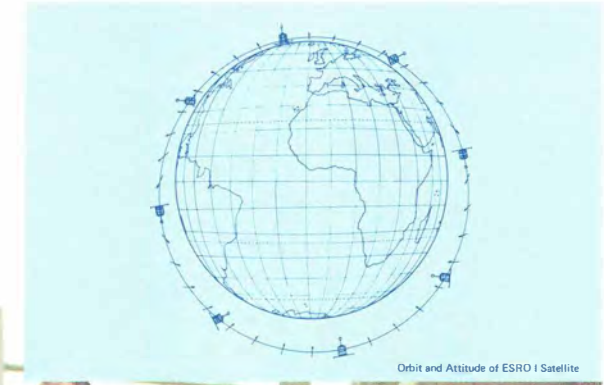
name	launch date	end of life
ESRO–2B	17.05.1968	09.05.1971
ESRO–1A	03.10.1968	26.07.1970
HEOS–1	05.12.1968	25.10.1975
ESRO–1B	01.10.1969	23.11.1969
HEOS–2	31.01.1972	02.08.1974
ESRO–4	22.11.1972	15.04.1974
Geos–1	20.04.1977	23.06.1978
ISEE–2	22.10.1977	26.09.1987
Geos–2	14.07.1978	25.08.1985
Ulysses	06.10.1990	
Eureca	31.08.1991	

astronomical missions

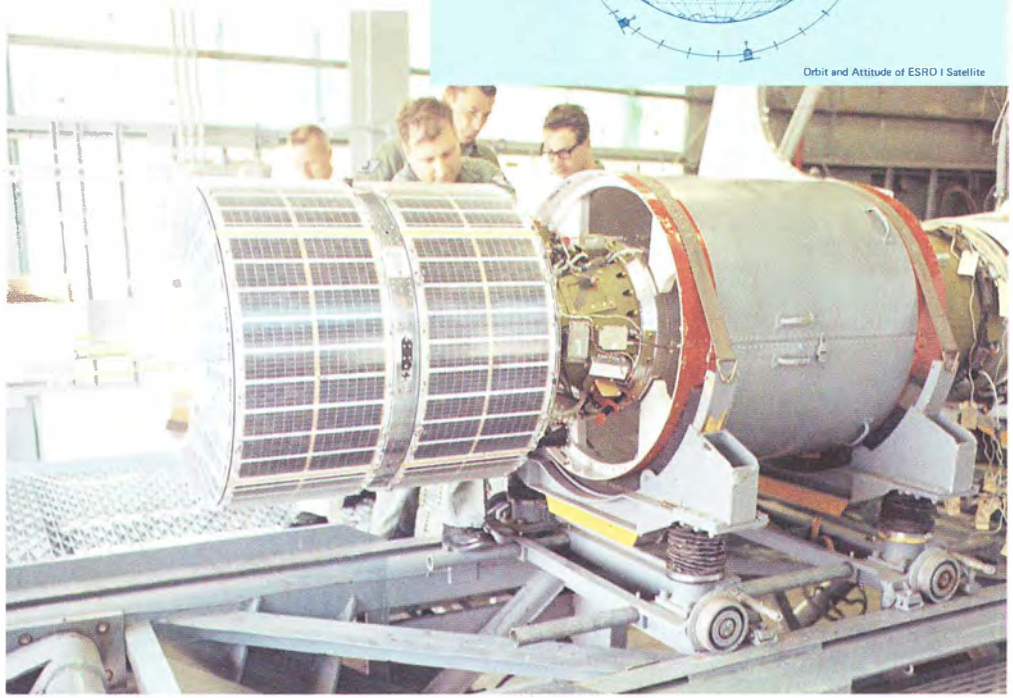
name	launch date	end of live
TD–1	12.03.1972	04.05.1974
Cos–B	09.08.1975	25.04.1982
IUE	26.01.1978	
EXOSAT	26.05.1983	09.04.1986
Giotto	02.07.1985	
Hipparcos	08.08.1989	
Hubble	24.04.1990	

The solar system (1) — yesterday's missions

Solar system missions reveal unknown phenomena which help us to understand better how the solar system was born and evolves. It corresponds to a deeper need of humans to be curious and to overcome their anxiety about their origins.



Orbit and Attitude of ESRO I Satellite



The missions of solar system satellites that have completed their life

ESRO-2B — cosmic rays and solar x-rays
ESRO-1A & -1B — auroral and polar cap phenomena, and ionosphere
HEOS -1 & -2 — solar winds and associated interplanetary field changes
ESRO-4 — neutral atmosphere, ionosphere, and auroral particles
GEOS-1 & -2 — Earth's magnetosphere
ISEE-2 — one of three satellites (the others supplied by NASA) studying the Earth's bow shock, magnetosheath and magnetopause

Solar system (2) — a new odyssey

Ulysses is a 'first' of considerable magnitude. It will be the first man-made object to fly over and observe the poles of the Sun.

The Ulysses mission is controlled by ESOC staff from the Jet Propulsion Laboratory (JPL) in California with our colleagues from NASA. Though working away from our establishment, we feel that we contribute daily to ESOC's long record of excellence

Ulysses was launched in October 1990 to explore the inner heliosphere over the full range of solar latitudes. After leaving the Earth, it journeyed first to Jupiter, reaching the giant planet in February 1992 - 778 million km away from the Sun. Using Jupiter's gravity to send a spacecraft on an orbit out of the ecliptic plane for the first time, ESOC spacecraft controllers, mission analysts and flight dynamics specialists redirected it over the South and North poles of the Sun which Ulysses will reach in 1994 and 1995 respectively.

The manoeuvre was achieved successfully with a targetting accuracy around Jupiter of some 400 km.

The Solar System (3) — Giotto

Most satellites would be satisfied with one mission, but not Giotto. Having led the fleet of spacecraft that encountered Halley's comet, and although battered by the encounter, Giotto was successfully put into long-term hibernation by ESOC staff, who found it, re-awoke it, and sent it on its travels to another comet. The latest news from the satellite is that it is feeling very well, and having achieved a 'first' for Europe by visiting two comets, would like ESOC staff to find it another comet to visit.

The Giotto spacecraft was launched on 2 July 1985 by an Ariane-1 rocket and flew by comet Halley's nucleus at a distance of about 600 km on 14 March 1986.

Put in hibernation, it was reactivated on 19th February 1990 and ESOC performed the first Earth gravity-assisted manoeuvre ever made on 2 July 1990 to redirect Giotto towards the comet Grigg-Skjellerup which it encountered on 10 July 1992.

This astonishing ESA scientific mission tested ESOC's abilities on four major occasions with a total success for spacecraft control, comet orbit determinations and Pathfinder project.

Giotto Dedicated Control Room at ESOC Darmstadt

Ever outwards (1) — yesterday's missions

Astrophysics and astrometry missions

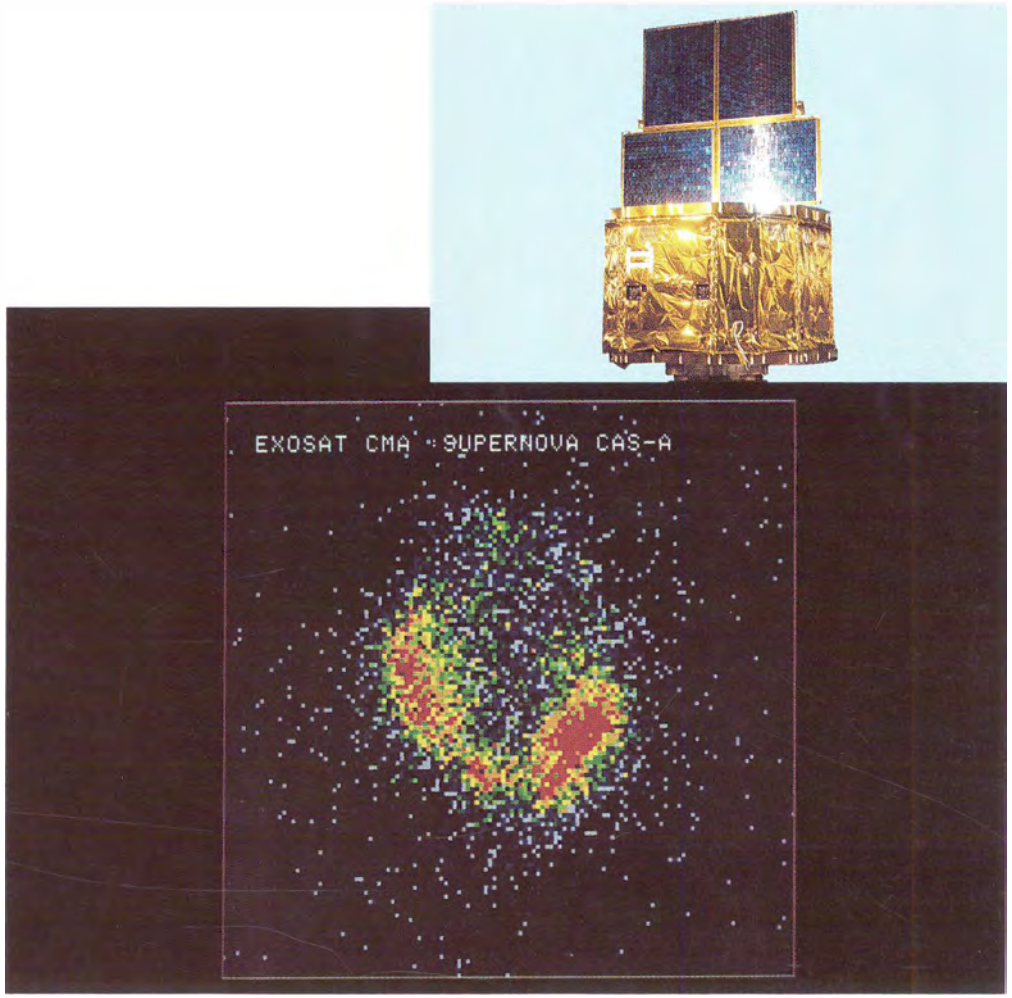
Our universe is full of stars which fascinate us. The greatest achievement of these satellites has been to reveal that celestial bodies have a life of their own and that there are plenty of them to discover. Since astrophysics and astrometry missions were first launched, we have gained more accurate knowledge of celestial bodies and can compare this knowledge with centuries old theories

Astrophysics missions that have completed their life

TD — Astronomy - Study of Ultra Violet, X- and gamma rays

Cos-B — production of the first catalogue of the celestial sphere seen in gamma rays with a telescope

Exosat — measurement of position and structure of celestial x-ray sources



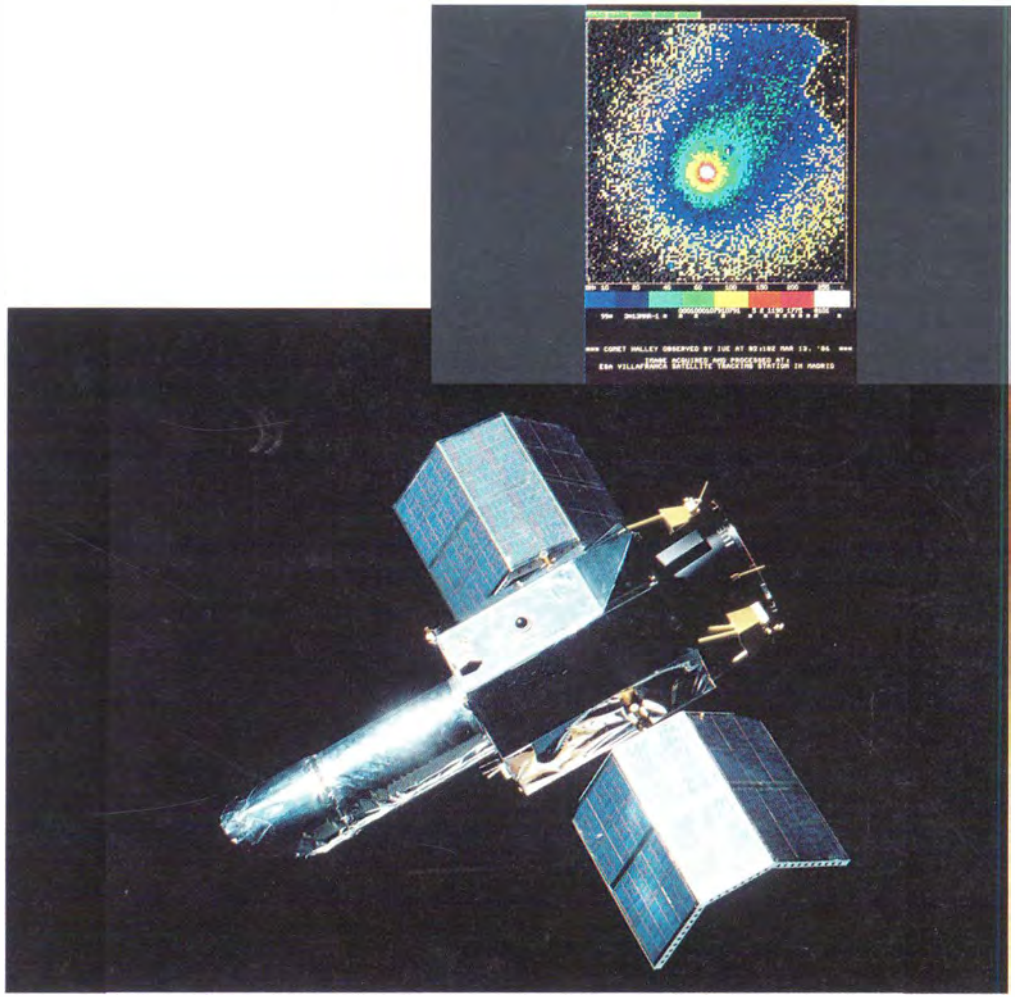
Ever outwards (2) — IUE

IUE (International Ultraviolet Explorer) turns out to be one of the most embarrassing of satellites; embarrassing in two senses. Firstly it has provided, and continues to provide an 'embarrassment of riches' in the quality and quantity of new phenomena across the Universe that it has discovered. Secondly it refuses to 'lie down and die', for it is still going strongly after fifteen years. The scientists are delighted, but it is a test for ESOC planners and controllers to continue servicing a mission that was due to end some ten years ago, but has now achieved a record in the history of spacecraft.

IUE's mission is to obtain ultraviolet spectra of astronomical sources. It was launched on January 26, 1978.

The satellite was designed and built co-operatively by NASA, the British Science and Engineering Research Council (SERC) and ESA. IUE operations are conducted jointly by NASA and ESA from two control centres, one located at the NASA Goddard Space Flight Center (GSFC) and the other located at the ESA Villafranca Del Castillo (VILSPA) Satellite Tracking Station, near Madrid, Spain.

Astronomers attend both centres to control and monitor their own observations.



Ever outwards (3) — Hipparcos

Hipparcos has the restless duty of a good libarian: to establish an updated star catalogue containing 100,000 stars with a precision 100 times better than that obtained on the basis of ground-based observations. And despite some hiccups in the early stages of its life, it is incredibly successful thanks to the abilities of its manufacturer and the inventiveness of ESOC staff.

The astrometry satellite was launched in August 1989, intended for a geostationary orbit, but it is now spinning in a geostationary transfer orbit (GTO).

The Apogee Boost Motor normally used to put a satellite from a GTO into a geostionary orbit failed. Thanks to the inventiveness and dedication of ESOC staff, they succeeded, after many attempts, in modifying the parameters of the orbit and the scientific mission has already produced excellent results.

An excellent advertisement for ESOC, but not an experience the staff would care to repeat.

Nation shall speak unto Nation (1)

— telecommunications

Nation shall speak unto Nation has become a reality thanks to telecommunications satellites.

Real-time television of international events, ship-shore communications, transport - home base links, videoconferencing .... the impact of telecommunications satellites on our lives grows daily.

ESOC has been controlling:

ESA Telecommunications satellites

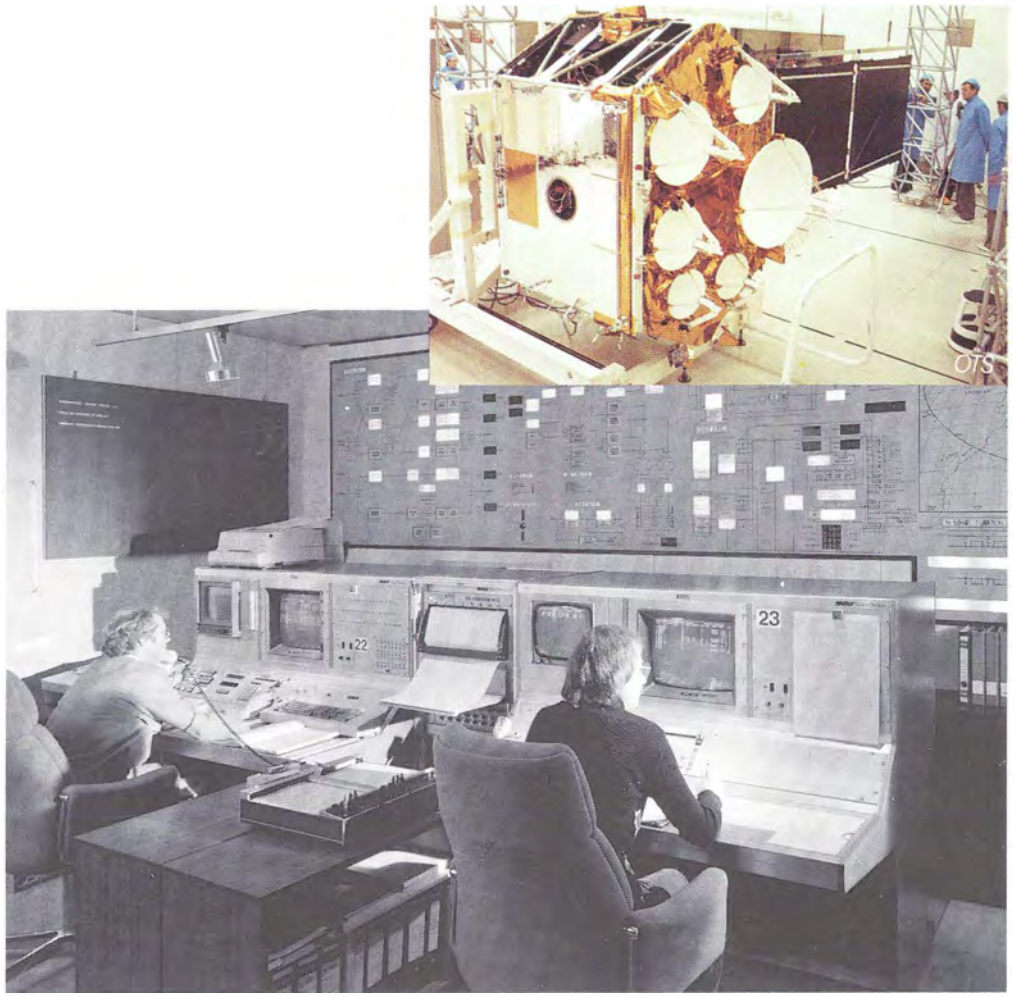
OTS-2	1978-1991
ECS-1	1983
ECS-2	1984
ECS-4	1987
ECS-5	1988
Olympus	1989

ESA maritime telecommunications satellites

Marecs-A	1981-1991
Marecs-B2	1984

ESOC also supported the Launch and Early Operations phase for an Indian, four French, one German and one Italian telecommunication satellite.

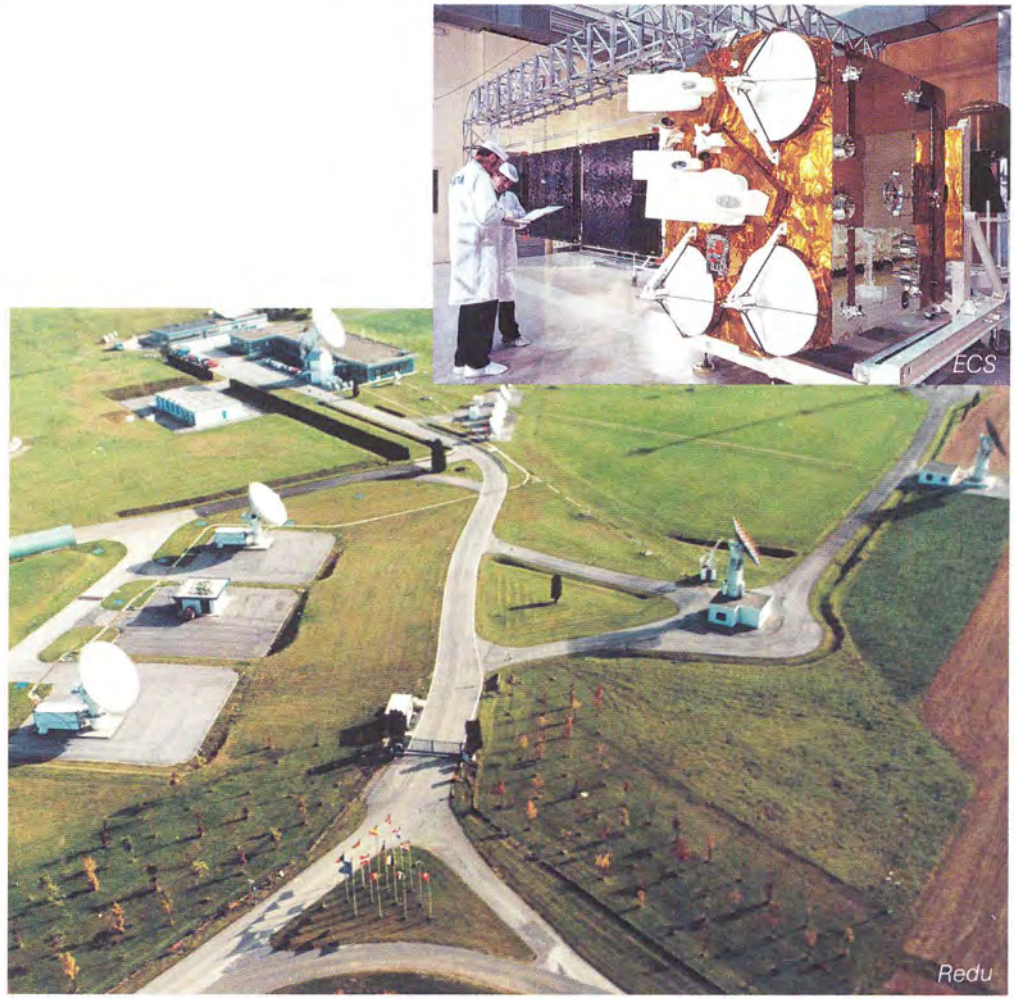
OTS-1, ECS-3, and Marecs B1 were lost due to launcher failures



Nation shall speak unto Nation (2) — OTS and ECS

The Orbital Test Satellite (OTS-2) was the forerunner of the European Communications Satellites (ECS). Without it we would not benefit from quicker, better telephone and television services.

One for the record — The ECS series has accumulated an operational life of more than 22 years satellite-years. The first ECS satellite had been in operation for eight and a half years when it was repositioned in 1991 - together with ECS 2 in preparation for future alternative operations. And the payloads of the four satellites operated by ESOC from Redu delivered over 200 channel-years of service.



Injected into geostationary orbit, **OTS-2** was used for a variety of experiments related to novel applications of communications satellites.

The series of European Communications Satellites **(ECS)** marked a new era in the use of telecommunications in our daily life.

Officially controlled for EUTELSAT (European Telecommunications Satellite Organisation) since 1984 from the ESOC ground station in Redu, Belgium, the geostationary satellites are used for telephony, television, radio and business traffic.

Nation shall speak unto Nation (3) — Olympus

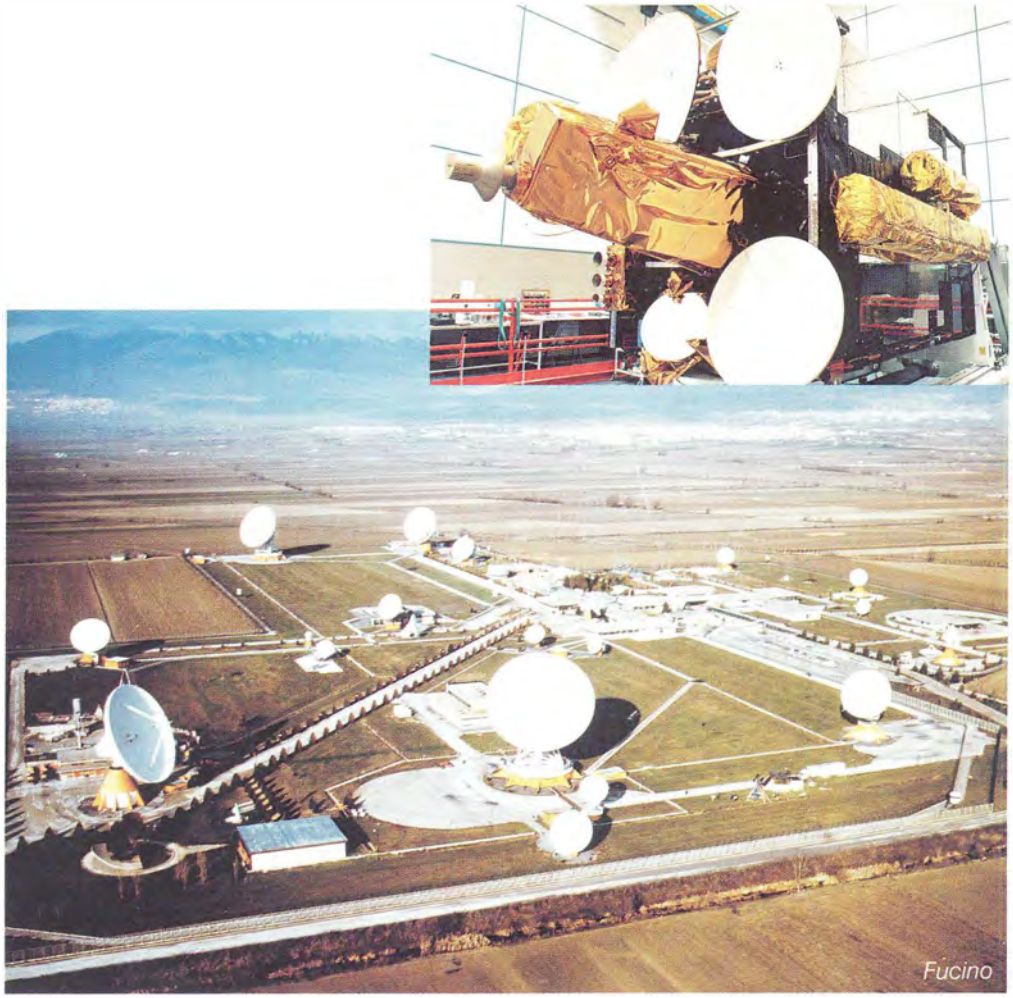
Olympus was ESA's answer to the question where do telecommunication satellite services go after ECS. It has show the potential of direct television and new fields of telecommunications such as teleconferencing.

For ESOC it has a more personal meeting. Thanks to the ingenuity, patience and sheer refusal to admit failure, Olympus back in action was the prize following the most daring recovery of a satellite ever to succeed.

Launched in July 1989 on Ariane, Olympus is testing new applications and hardware in the fields of direct television and telecommunications.

Following the sudden loss of attitude and orbit control of Olympus on 29 May 91 a 'rescue' team of ESA and British Aerospace specialists was put together urgently. The temperature of Olympus fell below -50°C, and even worse, no telecommands were executed onboard.

Thanks to the outstanding work of this team Olympus was recovered after one complete cycle around the Earth by mid-August 1991.



Fucino

Nation shall speak unto Nation (4) — from ship to shore

The Maritime European Communications Satellites (Marecs) which are similar to the ECS satellites make it possible for hundreds of ships at sea to communicate with each other, and with the land.

Since its earliest days the network of maritime satellites has contributed greatly to the safety and efficiency of shipping around the world.

Marecs-A & -B2 are owned by the International Maritime Satellite organisation, Inmarsat, London, UK and controlled by ESOC: (Marecs-B2 from Villafranca ground station in Spain, and Marecs-A used to depend on data transmitted from Ibaraki ground station in Japan). Both are in geostationary orbit.

Launched by Ariane in 1981, Marecs-A is still used for experiments while Marecs-B2 launched in 1984 is positioned at 22.5° East, and is fully operational, contributing to the worldwide coverage of Inmarsat.

Looking down on the blue planet (1) — Earth observation

Observing the Earth and its environment from space encompasses an extremely broad range of disciplines including such fields as meteorology, atmospheric physics, chemistry and dynamics, climatology, oceanography, glaciology, land processes, environmental factors and the solid Earth sciences.

The public is now well aware of the need for a greater knowledge of the factors that determine our climate, and through its meteorological satellites, and more recently the European Remote Sensing satellite ERS-1, ESA has been in the forefront of activities in this field. ESOC has played a key role, not only in control of the satellites, but in the retrieval and dissemination of essential data.

Satellites controlled from ESOC and its ground stations

Meteorological satellites
Meteosat 1 1977-1985 (represented ESA's first contribution to the international World Weather Watch of the Global Atmospheric Research Programme (GARP).
Meteosat 2 1981-1991
Meteosat 3 1988
Meteosat 4 1989 (MOP-1)
Meteosat 5 1991 (MOP-2)

Remote sensing satellites
ERS-1 1991

In addition ESOC has supported operations for a USA, and an Indian meteorological satellite, and two Japanese Earth observation satellites.

Looking down on the blue planet (2) — Meteosat

The animated weather forecast charts that are nightly fare for television viewers across Europe are the 'tip of the iceberg' for meteorologists. Data from the Meteosat satellites play an important role in building greater knowledge of the mechanics underlying our climate, and helping long-term predictions.

Without weather satellites, we would not be able to predict weather with the accuracy required by modern agriculture, air companies, agronomers, shipping or the man in the street. Since 1977 ESOC has been providing Meteorological offices in Europe and Africa, and research centres with a constant flow of valuable data.

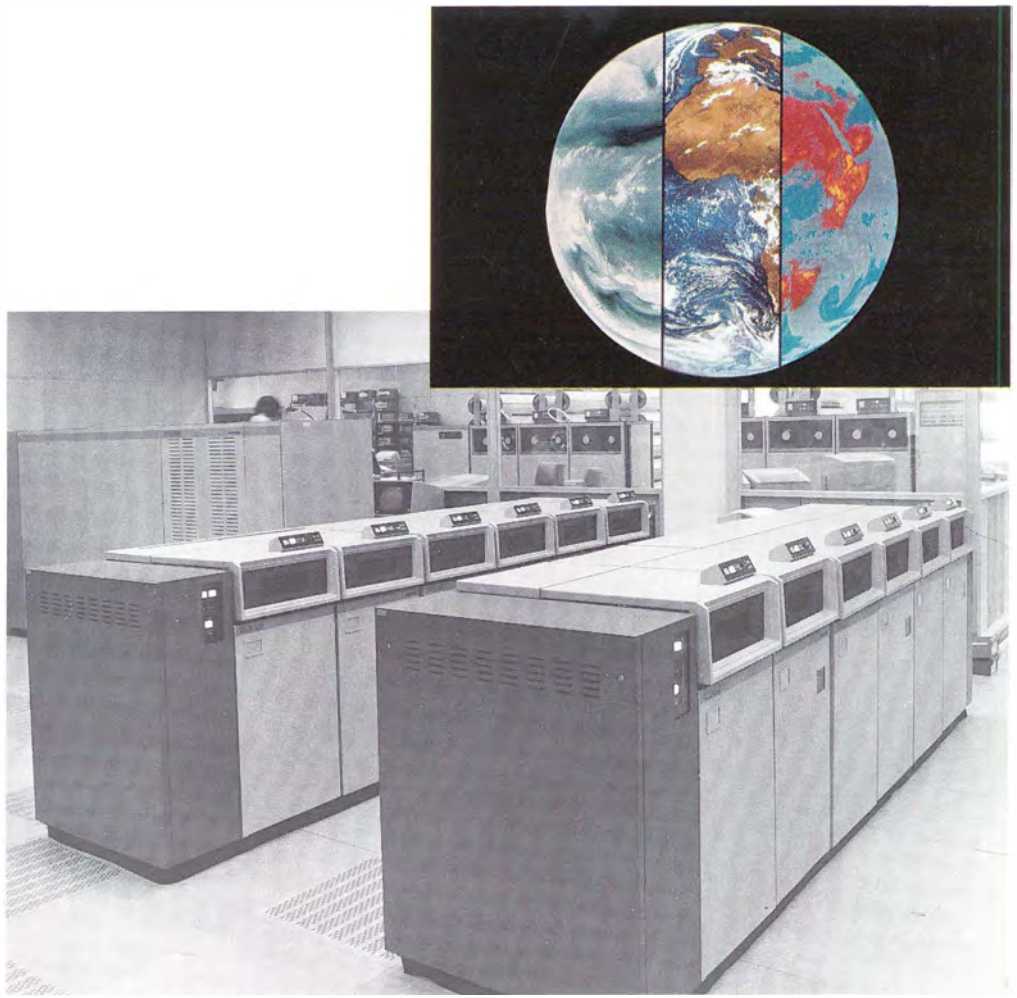
Since the beginning of the Meteosat programme in 1977 ESOC has been controlling the Meteosat satellites and exploiting the raw data transmitted to the meteorological offices. Since 1987 it has been operating the satellites on behalf of the European Meteorological Satellite organisation, EUMETSAT.

The operational satellites (MOP-1 and MOP-2) are positioned in geostationary orbit at 1°West, and 4°West respectively over the gulf of Guinea (Africa). Meteosat-3 was shifted towards the United States within the Atlantic Data Coverage programme.

The largest meteorological satellite archive in Europe is housed in ESOC

Looking down on the blue planet (3) — data from meteosat

Supplying information on the weather is a non-stop process. Every half-an-hour the data transmitted by Meteosat are processed in ESOC and sent back via the satellite to the researchers and other users. In this way a large body of information is being built up, leading to a greater understanding of our weather.



The images produced by Meteosat are not only in the visible spectrum that we see on our TV screens. There are channels producing data on water vapour, and in infrared. The weather forecasting offices in Europe add these data to those received from ground and sea stations. Maps that show the direction and speed of the winds at different altitudes are established every six hours for use by the airline companies, thus helping towards safer and more economical use of air travel.

The more the meteorologists can learn from Meteosat data, the greater influence they can have in helping to save lives, and minimise damage due to extreme and unusual weather conditions.

Looking down on the blue planet (4) — remote sensing

Looking down, looking forward has been the catchphrase for Earth observation scientists. Thanks to the success of the European Remote Sensing satellite (ERS-1), European scientists have now a tool that looks down on the Earth with great precision, and gives them hope of looking forward to years of data on which to build knowledge of our environment, information on sea states of direct interest to shippers, oil-platform owners and fisheries, and the monitoring of crops, desertification and other phenomena affecting life, and the results of pollution. From the beginning ERS-1 has been working superbly, providing scientists with the highest quality and quantity of data. From Day 1, ESOC has been at the hub of the regular operations of Europe's most advanced Earth observation satellite.

The European Remote Sensing satellite (ERS1), launched on 17 July 1991 by Ariane-4, has an expected lifetime of four years. It is the first civil remote sensing satellite using advanced microwave/radar techniques enabling data to be provided day and night irrespective of cloud and sunlight conditions.

All the instruments on board are controlled from ESOC and the data are collected by several ground stations around the world.

Flying Free — Eureca

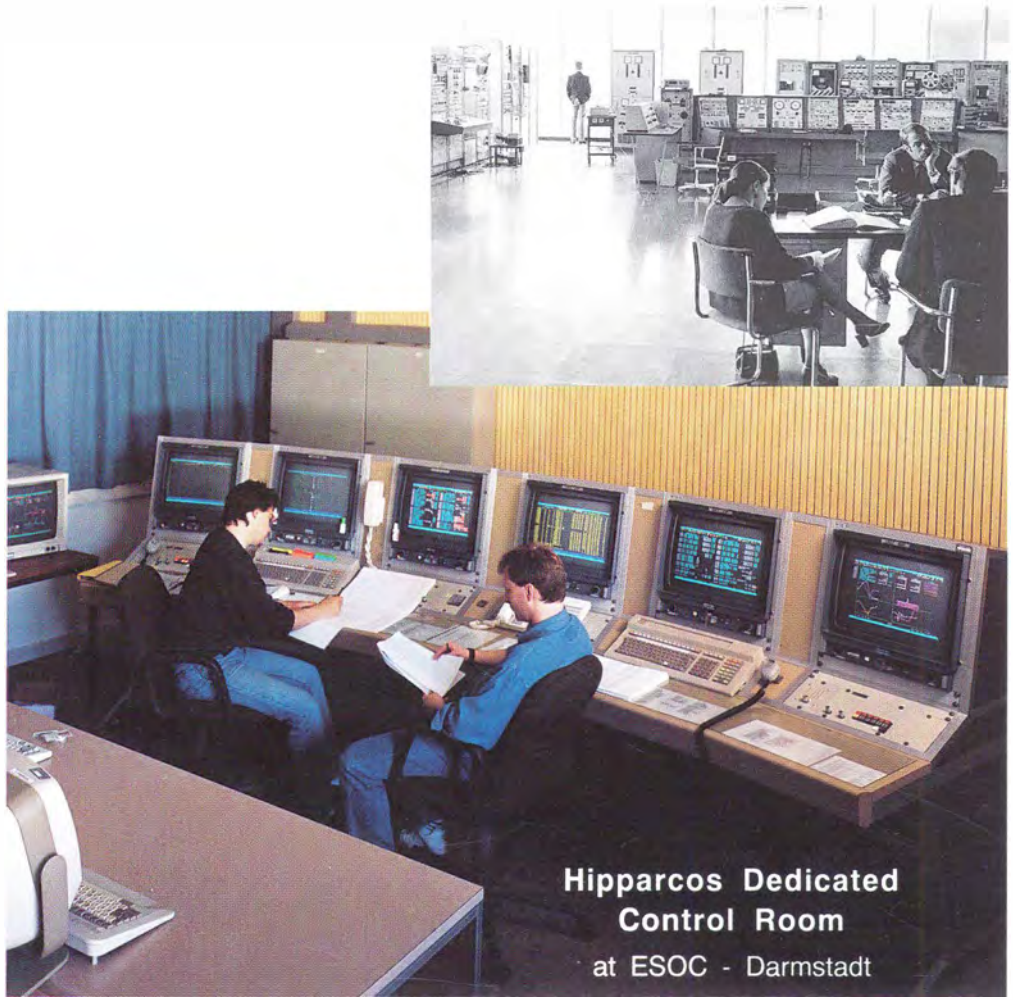
The European Retrievable Carrier (Eureca) opens up a new chapter in space exploration and exploitation. The concept of being able to leave a spacecraft in orbit for up to nine months, and then to retrieve it, and its payload is so novel that it could have far-reaching effects on the thinking of those who plan new space missions. Eureca is a unique platform of its kind, offering over eight months of uninterrupted microgravity conditions never experienced until now. It is only visible from the ground for about 3% of the mission, so the Eureca Operations Control Centre will prepare and uplink up to 1000 telecommands to control the satellite and guarantee that the scientists can follow their experiments and receive their individual data without ESOC looking into them.

Eureca was launched on 31 July 1992 onboard the Atlantis Shuttle. The 4.5 tonnes platform carries a one tonne payload. Eighty percent of the Eureca payload is made up of life and material sciences facilities. The remaining 20% is devoted to space science and technology experiments, among which is the Inter-Orbit Communication Instrument that might improve tremendously the flow of control data for low earth orbit (LEO) satellite.

After release ESOC has been totally in charge of the platform and the switch-on of all instruments on board. All data, whether related to the satellite or the experiments, flows through ESOC until the spacecraft is recovered after a planned mission duration of eight months.

All in the day's work (1) — preparing for, and operating satellites

The launch of a satellite is spectacular, and catches the public eye, but even the most perfect launch is of no avail if the ability to monitor and control the spacecraft and its payload is not equally perfect. To achieve 'operational state-normal' calls for several steps over a long period. These are highlighted in the following pages under 'preparing missions', 'on track' and 'megabytes on megabytes'.

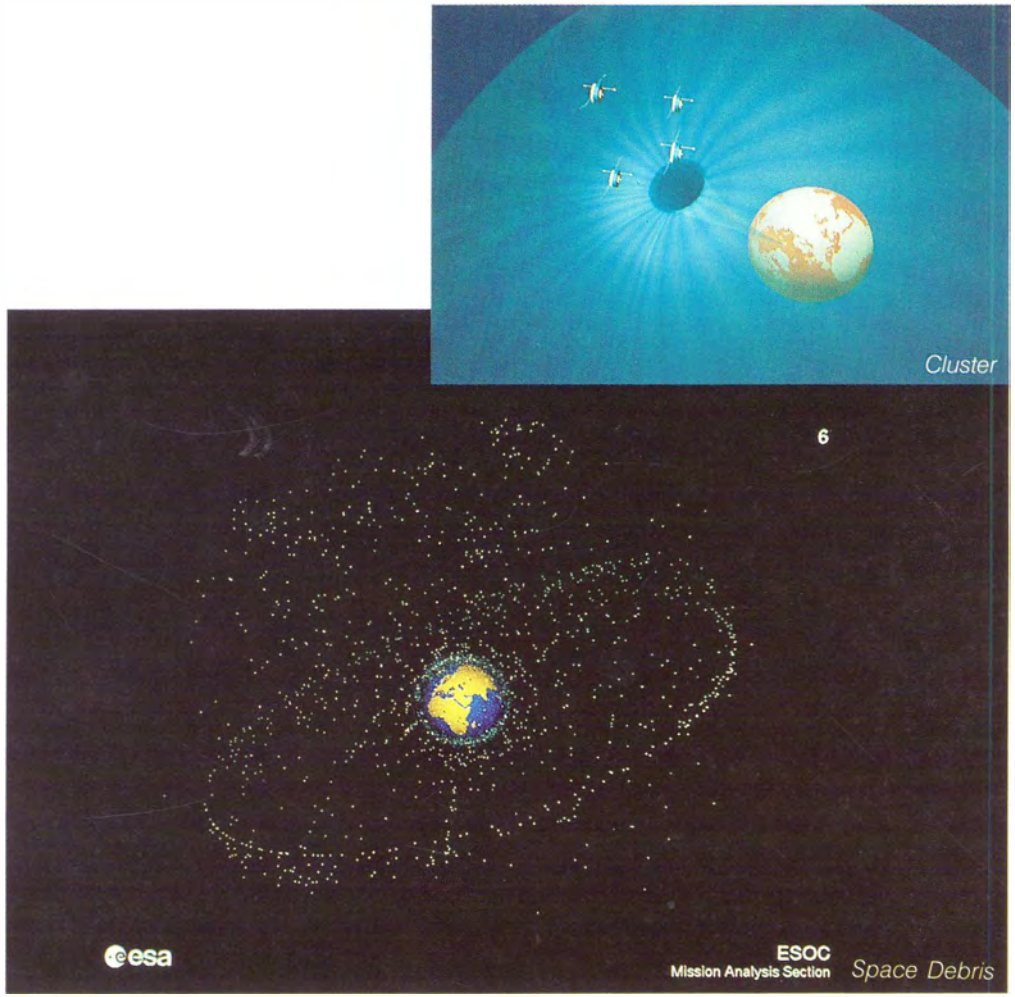


Hipparcos Dedicated Control Room
at ESOC - Darmstadt

All in the day's work (2) — preparing missions

Mission analysis is the backbone of any sensible future work. However attractive a proposed mission may look, ESOC's mission analysts have first to identify the best possible orbit or trajectory and attitude needed to meet the aims of the missions. They offer trade-offs between the dreams of the scientists, the ambitions of the engineers and the physical laws, a task requiring rigour and ... diplomacy.

The mission analysts study a mission proposal many years before launch and refine the solutions suggested as the project evolves. They choose an orbit (low circular, highly eccentric, geostationary, etc), evaluate the means to be used to reach the target (spacecraft propulsion or planet gravity assist manoeuvre), the angle with which the target should be approached, and they influence the choice of daily slots when a launch may take place. Their tasks also extend to calculating launcher trajectories in order to define the maximum spacecraft mass as well as working out ground station contact times. More recently they took a leading role in studying the impact of space debris on the space environment and in developing a mathematical model.



All in the day's work (3) — flight dynamics

The work of the flight dynamics specialists is largely governed by mathematical laws that have remained unchanged since Johannes Kepler and Leonard Euler. It is necessary to be aware, however, that the complexity and the multiplicity of ESA missions have considerably modified the work of flight dynamics specialists over the years. In 1967 ESOC employed one mathematician. In 1992 the team includes 26.

ESOC's flight dynamics specialists provide the spacecraft controllers and the users with the exact location of the spacecraft in its orbit and the direction in which it is facing. Trained in orbital mechanics and spacecraft dynamics, they can also perform all the calculations required when changes to the spacecraft's orbit and attitude have to be made.

They have to take many factors into account such as the gravitational field of the Earth and other celestial bodies influencing the mission, the atmospheric drag, the behaviour of the spacecraft itself. They derive a mathematical model from these estimations and then carry out a number of measurements to assess the real behaviour of the spacecraft.

All in the day's work (4) — on track — the story of Estrack ESA's Ground Station Network

Without a reliable and comprehensive network of ground stations, ESOC could not do its job. No signals, no mission: the telemetry and telecommand data are vital, wherever the spacecraft is. The ground stations bridge the gap between the satellite, the spacecraft controllers, and the data users.

Details of Estrack are given below, but occasionally networks of various national space agencies round the world such as the NASA Deep Space Network, and French stations in Africa have to be called on to provide support. The international nature of space work, and the high level of cooperation is well illustrated at such times.

ESTRACK is the complete network of ground stations around the world set up first when the control centre was in Noordwijk (The Netherlands) and then expanded by ESOC over the years.

It comprises two main categories of ground station: the general purpose ground stations which can support almost any type of mission, and dedicated stations designed to support either one specific spacecrat or series of spacecraft.

ESOC also uses national ground stations during the Launch and Early Orbit Phase. There are three such stations, located near to the Equator: Kourou, French Guiana, Malindi, Kenya, and Perth in Australia.

Ground Configuration Control Room
at ESOC - Darmstadt

All in the day's work (5) — on track — ESA ground stations in Europe

The map of Europe can sometimes look deceptively small, but the reality is well expressed by the distances between ESA's ground stations in Europe, ranging between the Artic circle, and the shores of North Africa, from the Atlantic to the Baltic.

Fucino, Italy
National ground station used as the control centre for Olympus

Maspalomas, Canary Islands, Spain
Prime station for Eureca

Michelstadt, Odenwald, Germany
Primary tasks associated with Meteosat series of satellites.

Redu, Belgium
In the 1960s and 70s supported scientific satellites. Present tasks — round the clock coverage of the ECS series

Salmijaervi, Kiruna, Sweden
Situated at 68° N: primary task reception and processing of ERS-1 data.

Villafranca, Spain
Main task has been IUE, since 1978. Also associated with Exosat, and Marecs, and in the future will support the Infrared Submillimetre Observatory (ISO)

All in the day's work (6)
— on track
— other ground stations

There are many instances during the lifetime of a satellite, depending on its orbit, when it is out of range of the ESA ground stations in Europe, but control has to be exercised, or data retrieved. At such times, ESA has access to stations on other continents.

Kourou, French Guiana, S. America
This ground station is closely associated with launches of Ariane vehicles. It tracks satellites in geostationary transfer orbit, and also plays a role in the Eureca mission.

Ibaraki, Japan
Used for operations of Marecs-A in the 1980s, and for early phases of some ECS and Meteosat spacecraft.

Malindi, Kenya, East Africa
Tracking station for satellites in transfer orbit

Perth, Australia
Tracking satellites in transfer orbit, Hipparcos, and Eureca.

Carnarvon, Australia
Now closed. Used for the Giotto encounter with Halley's comet.

All in the day's work (7) — Opsnet and Esanet the telecommunications networks

Telecommunications engineers work wonders to make sure that the link is established between the ground stations and the control centre or between the establishments; round the clock they make sure that the satellite data can be transmitted via Opsnet, and that everyone within ESA can communicate their messages via Esanet.

The number of ground stations and missions running simultaneously has increased steadily, and with this increase has come the need for the rapid exchange of databanks, and all forms of communication.

As a result, the role played by telecommunications has become much more significant. The requirements change more rapidly than in any other area as the Agency extends the number and siting of its contact points and the variety of data collected from its satellites.

All in the day's work (8) megabyte on megabyte the story of ESA's computers

In the space world, everywhere you run into a computer, big or small, whether you are controlling a satellite, modelling an orbit, processing huge amounts of data, or sending electronic mail. This is a far cry from twenty five years ago, when personal computers had not arrived in offices, and the capacity of the mainframe computer bore no comparison with today's Distributed Mission Support System. The definition, implementation, control and updating of the ESA-wide computer system network is the responsibility of the ESA Computer Department located at ESOC. The computing facilities have evolved since the early days to a situation where there are two major computer centres and still further data processing facilities are needed to support future missions. Today's computer network consists of *real-time* and *general purpose* systems.

Real-time systems
Operation of spacecraft, analysis of all forms of data from satellites, sending of commands. *Multi-Satellite Support System (MSSS)* can support several missions at the same time; also the Launch and Early Orbit phase of geo-synchronous missions. MSSS runs applications for ECS and Marecs missions. *Meteosat Ground Computer System* supports high rate of imagery data stream from Meteosat. *Distributed Mission Support System* is supporting Hipparcos, ERS-1 and Eureca, and will gradually take over from MSSS.

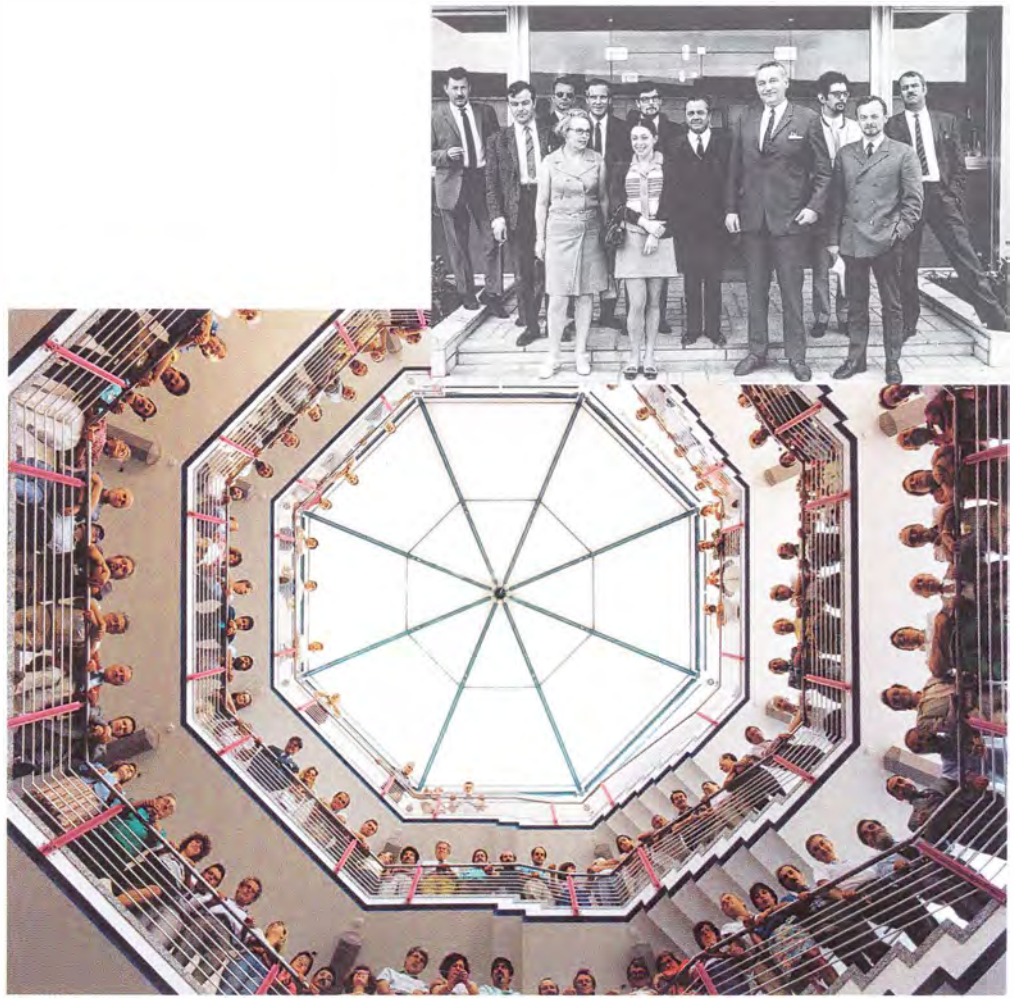
General Purpose Systems
The network of large computer facilities common to the whole of ESA is centred round two mainframe computers at ESOC and one at ESTEC. Applications range from structural calculations, to management systems, and electronic mail within ESA and beyond.

Main Control Room
at ESOC - Darmstadt

Serving space

People have been and will remain the key to success in space work. That modern space research is impossible without computers is true; but computers are only as good as the people who design the hardware and software, and operate them.

It is people who rally round and find the answers to desperate situations such as the early days of Hipparcos, and the troubles with Olympus. It is people, 333 in ESOC who, together with hundreds of contract staff, (at peak times nearly 700) can make the proud boast *'the impossible just takes a little longer'.*



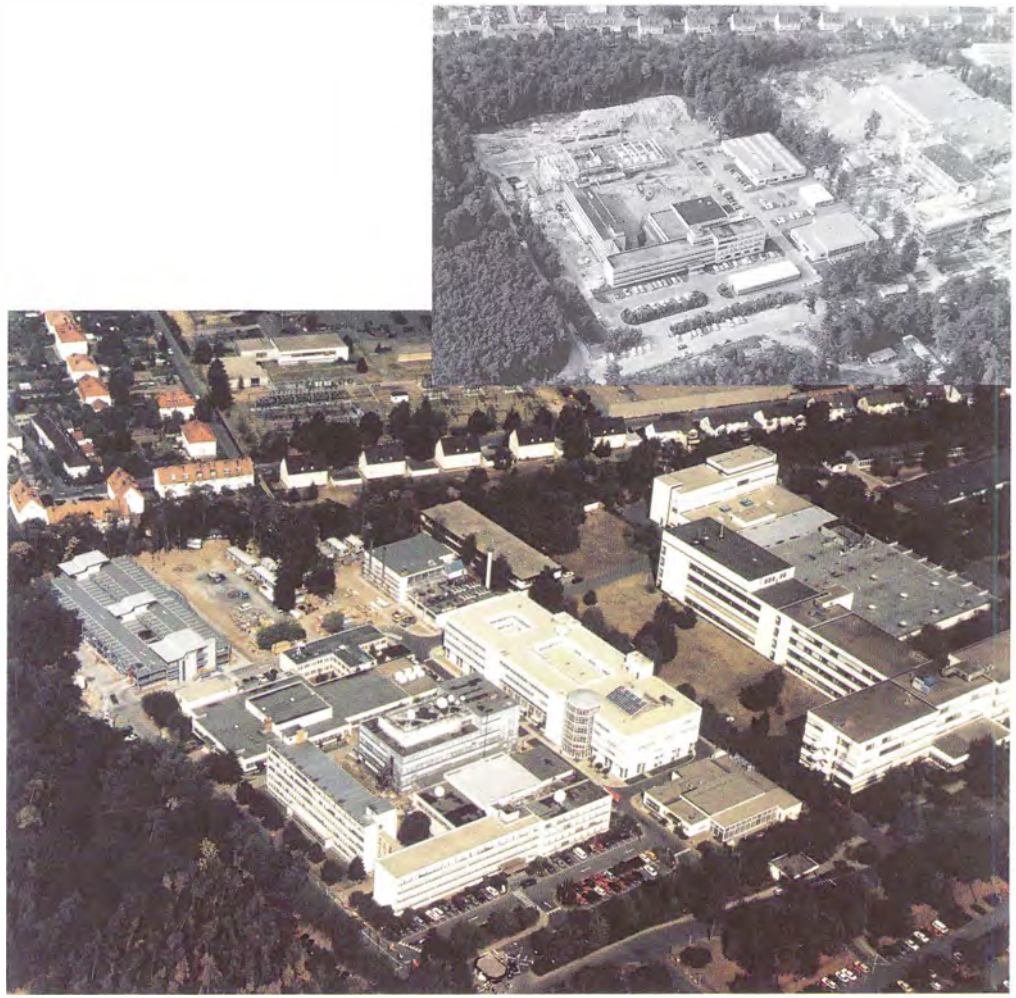
The predecessor of ESOC, ESDAC, came into being in 1963 in anoffice of the Deutsche Rechenzentrum (DRZ) in the Rheinstrasse in Darmstadt. Early in 1964 the small staff moved to their new accommodation in the Havelstrasse. It was only in 1967 that the growing staff (now numbering 53) were relocated to the new establishment built in the Robert-Bosch-Strasse.

ESDAC was renamed ESOC when control centre staff arrived in 1967 from ESTEC, Noordwijk.

As the responsibilities of ESOC have increased there have been corresponding increases in staff culminating in today's total of 333.

On site

ESOC welcomes thousands of visitors a year. In 1967 it was easy to direct visitors to their destination: there was after all only one building. Today the destination could be in any one of six buildings.



Some facts about the site

In the beginning 2000 square metres were needed: today there are 29,934 square metres.

Document copying is one 'barometer' of activity in an organisation. In 1967, the ESOC reproduction services made 60,000 copies: in 1991 the number had risen to ten million units.

The General Stores received 16,970 packages with a total weight of 287,410 kg in 1991. It was a matter of a few thousands in the early days.

There was a spate of building in the 1970s, then a lull until the 1990s when the new block, the parking lot, and the energy centre were constructed.

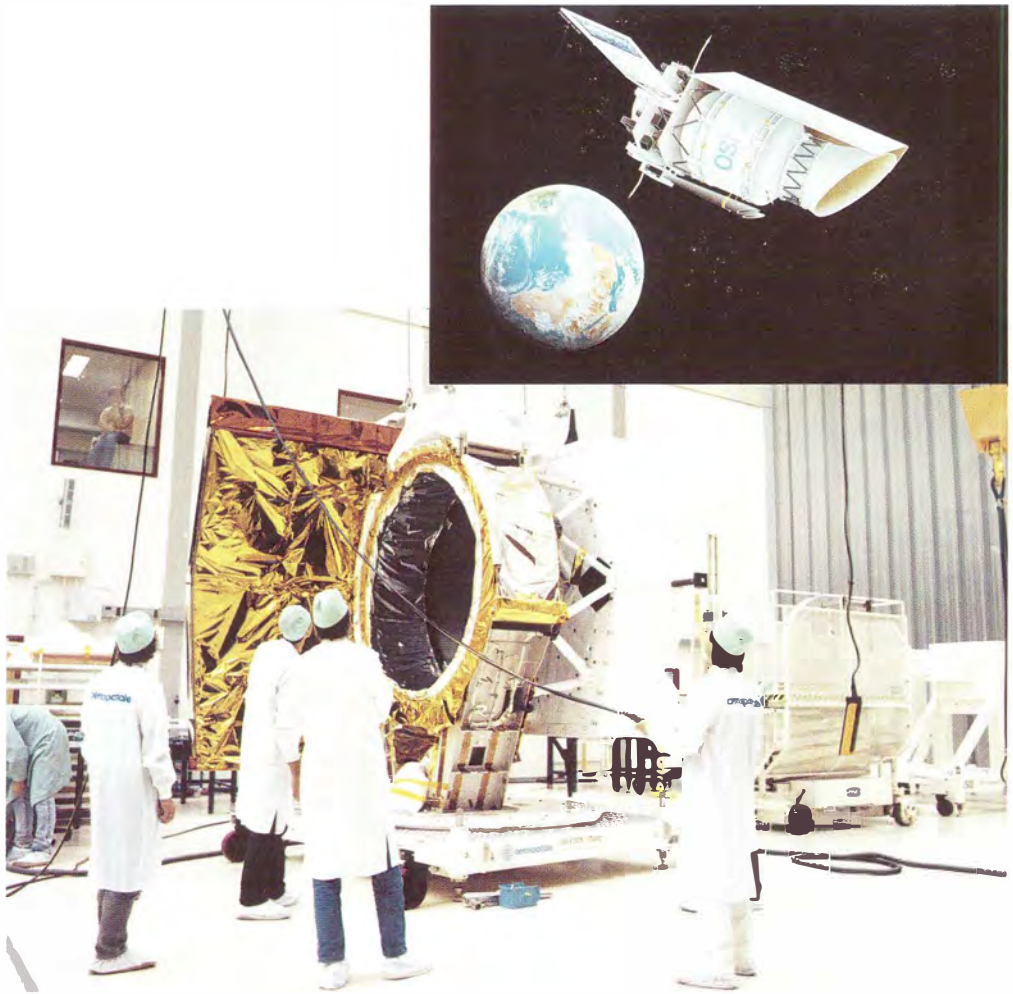
On the lighter side — social events

All work and no play makes Jack a dull boy — but the Jacks and Jills of ESOC have talents beyond those called for in their working lives. As a result a large number of social and sports clubs have burgeoned where the talents and goodwill flourish. With some 30 clubs spanning activities as diverse as soccer, golf, skiing, tennis, theatre, choir singing or Classical Ensemble, everyone working on the site has a chance to participate. The quality of the theatre performances is such that the club recently won the 1992 Festival of European Anglophone Theatre Societies. The sports and social clubs are always closely associated with any ESOC celebration.

Looking ahead with confidence

Every mission at ESOC has been a stepping stone for a new challenge which we met successfully, preparing flights years before launch while colleagues from other ESA establishments were preparing the spacecraft. Missions have required particular imagination and flexibility from staff to meet unexpected developments.

ESOC has had to cope with very demanding situations. Based upon the expertise and confidence built during the last two and a half decades, the staff at ESOC look forward to all the 'tomorrows' sure of its role and share in the success of ESA future missions.



Some concepts of future missions to be controlled by ESOC

At the time of going to press, the detailed future of some ESA programmes has still to be determined, but ESOC expects to play a major role in the following missions, and activities:

Earth Observation

Meteosat MOP3, Meteosat Transition Programme, Aristoteles, a polar orbiting mission, a Meteosat 2nd generation mission.

Space Science

Infrared Submillimetre Observatory (ISO), Cluster, Huygens probe, XMM (X-Ray Multi-Mirror Mission), Rosetta .

Telecommunications

Artemis, Data Relay Satellite (DRS)

Manned Flight

In-Orbit Infrastructure.