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EUMETSAT

Europe's Weather Satellite Organisation

First Meteosat Second Generation spacecraft soars to success

Shouts of jubilation combined with sighs of relief as the first of EUMETSAT's new generation of weather satellites underwent a text book launch on 28 August from Kourou, Europe's spaceport in French Guiana.

A 24-hour launch delay, due to a routine communication glitch with the Ariane-5 launcher, was worth the wait after almost two decades of dedication and hard work to produce a satellite that will make significant contributions to improved weather forecasting and better our understanding of the planet's climate and its potential changes.

Following in the footsteps of the very first Meteosat satellite 25 years ago, MSG-1 underwent the separation and injection into orbit without a hitch and is now safely ensconced at 10.5°W.

The sophisticated satellite is set to relay test images from 36,000 km above the Earth to EUMETSAT's Control Centre in Darmstadt, Germany, during a year-long commissioning phase.

MSG-1 has a payload of three instruments, the primary one being the SEVIRI (Spinning Enhanced Visible and Infrared Imager). This radiometer will build up images of the Earth's surface, the atmosphere and cloud cover in 12 different wavelengths once every 15 minutes, compared with three wavelengths once every 30 minutes with Meteosat.

MSG-1 will offer weather forecasters and climate modellers more advanced images and data than its predecessors. The more frequent imagery means meteorologists will be better placed to interpret evolving weather conditions and the SEVIRI data will significantly enhance short-term forecasting.

The launch of MSG-1 by Ariane-5 from Kourou, French Guiana

Dr. Tillmann Mohr, Director-General of EUMETSAT, said: "The launch of MSG-1 was a significant milestone in the greatly enhanced observation of the planet's weather and long-term climate from space."

Mr. Peter Ewins

EUMETSAT's new Council Chairman

Mr. Peter Ewins, the Chief Executive of the Met Office (UK), was elected as the fifth Chairman of the EUMETSAT Council at its meeting at the end of June. He succeeds Dr. Henri Malcorps of Belgium, the Chairman since 1998. Mr. Declan Murphy, Director of Met Éireann, was elected as Vice-Chairman.

Mr. Ewins sees his role as enabling the business of the organisation to proceed in a pragmatic way based upon strategic thinking. He regards excellence as paramount in the science of meteorology and wishes to ensure that the views of Member States are properly presented and debated in Council meetings.

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5th EUMETSAT User Forum in Africa

Over 160 participants from 50 African countries and more than 12 European countries met for the 5th EUMETSAT User Forum in Dakar, Senegal, between 30 September and 4 October 2002. It was hosted by the Ministry of Equipment and Transport of Senegal and supported by the Direction de la Météorologie Nationale (DMN).

Its global objective was to reinforce the already well-established dialogue between EUMETSAT and its African user community, optimising usage of satellite data on the continent and ensuring that the actions taken by EUMETSAT actually meet the specific requirements of its African partners.

Preparing the African National Meteorological and Hydrological Services (NMHS) for the implementation of the PUMA project was another objective of the Forum.

Sessions were held to discuss the detailed implementation of the technical activities related to the provision of MSG receiving stations in all African countries, and the implementation of training and outlook activities.

During these sessions, the MSG receiving stations were demonstrated and all attendees were briefed on how to prepare their site for the reception of the MSG stations.

Training plans were also discussed and relevant recommendations made to the PUMA Project Management Unit (PMU) for ensuring the successful implementation of this key component of the project.

Delegates from Africa and Europe at the 5th EUMETSAT User Forum in Dakar

On outlook activities, the participants from Brazzaville in the Republic of Congo had prepared a case study of a potential pilot project, which was presented and discussed during the parallel sessions. As a result of these sessions, relevant recommendations were made.

Working sessions were held to describe the latest developments made within EUMETSAT since the Kampala Forum of 1998 and to present the training programmes developed by EUMETSAT in Africa. A particular emphasis was put on the presentation of the Meteosat Second Generation programme which, after the successful launch of MSG-1, represents a clear opportunity for the African NMSs to improve their role and visibility.

Finally, a thematic half-day session focusing on marine meteorology was scheduled and, thanks to the support of Météo-France, a detailed presentation of an operational marine meteorology service was presented. Specific marine applications in Africa were then presented by the participants.

User Service spreads its wings

The EUMETSAT User Service has been in action as far afield as Bulgaria, Estonia, the Czech Republic and for the first time Jordan and also Russia – all in addition to ongoing support with training events in EUMETSAT Member States and in Africa.

The courses in Africa, coordinated with the World Meteorological Organization (WMO) and hosted at regional centres in Kenya and Niamey, have been focusing on the applications for the eagerly awaited MSG data to be made available to African states through the PUMA initiative.

As part of conscious efforts to extend its training activities in Portuguese-speaking countries in Africa and South America, EUMETSAT supported a training event in Portugal and plans to support a satellite meteorology course in Brazil.

Similarly, plans are under consideration for focusing training support on the Ibero-American community (Spanish-speaking states in Europe and Central/South America).

The external contract for the development of the so-called MSG CAL (MSG Computer Aided Learning) modules and tools was completed with the delivery of three CAL modules and a tool set enabling the creation of additional modules.

Workshop on Severe Convective Storms (21-23 August 2002, Prague) jointly organised by EUMETSAT and CHMI (Czech Hydrometeorological Institute)

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PUMA and beyond

Hand-over of the Dakar Declaration on AMESD by the PUMA Task Team Chairman to the EC representative (from left): Mr. Evans Mukolwe, Director Coordinator with the World Meteorological Organization, Chairman of PUMA Task Team; Mr. Alioune N'Diaye, Director of Direction de la Météorologie Nationale of Sénégal (host); and Mr. Amos Tincani, Advisor of the Director General, European Commission, Directorate General for Development

The first MSG receiving stations will be installed in six African countries during early 2003 – Kenya (Drought Monitoring Centre/DMC), Senegal (ASECNA), Niger (AGRHYMET), Cameroon (NMS), Zimbabwe (Drought Monitoring Centre/DMC) and Mauritius (NMSs).

Initial training events – from an expected total of 17 – will take place in parallel, and after six months of on-site testing the rest of the stations for the remaining African countries will be completed and installed by the end of 2004.

Completion of the first phase follows the European Commission's award of a contract covering MSG receiving stations for all African National Meteorological Services as part of the Preparation for Use of MSG in Africa (PUMA) project.

The contract was awarded to the French company Alcatel Space in consortium with the German-based VCS GmbH, and the receiving stations will operate the Messir System developed by Corobor of France.

During the 3rd meeting of the PUMA Project Steering Committee, the Project Management Unit, run by the French company ACRI TA, presented preliminary versions of reference documents for the implementation of the training and outlook activities components of PUMA.

At a meeting in Dakar on 29 September, the PUMA Task Team began planning the African Monitoring of the Environment for Sustainable Development (AMESD) project, a follow-up initiative to PUMA.

Representatives of the Executive or General Secretaries of the five African Economic Groupings represented in the PUMA Task Team signed the Dakar Declaration on AMESD and it was subsequently presented at the opening of the 5th EUMETSAT User Forum in Africa on 30 September 2002.

With this Declaration, the five Economic Groupings have officially requested the European Commission to finance a feasibility study on AMESD and this is planned to start in the first quarter of 2003.

Signing of the Declaration on AMESD (from left): Colonel Benjamin N'Dala, Director of Transport and Telecommunication, Representative of the Executive Secretary of CEMAC (Communauté Economique et Monétaire de l'Afrique Centrale), Mr. Debalkew Berhe, Director for Environment, Representative of the Executive Secretary of IGAD (Intergovernmental Authority on Development), Mr. Wilfrid Bertile, Executive Secretary of Indian Ocean Commission, Mr. David Kamara, Director of Transport, Representative of the Executive Secretary of ECOWAS (Economic Community of Western African States), Mr. Sipho Dlamini, Director of Telecommunications, Representative of the Executive Secretary of SADC (Southern African Development Community). Standing: Mr. Paul Counet, Strategy and International Relations Officer, EUMETSAT

Director-General's Desk

There is something special about the launch of a satellite. The experience is even more significant when it is the first of a new range of satellites, particularly when you have been involved with it from conception 18 years ago.

The first formal discussions on Meteosat Second Generation (MSG) took place at a meeting in Avignon, France in 1984 and some of the ideas to emerge from that famous meeting are to be found in the reality of the satellite launched into space on 28 August.

There have been changes along the road to this success through technical and financial constraints. Early ideas foresaw a three-axis stabilised spacecraft with humidity and temperature sounders. In reality we now have a spin-stabilised satellite with an advanced imager and an instrument to detect the radiation budget of the Earth.

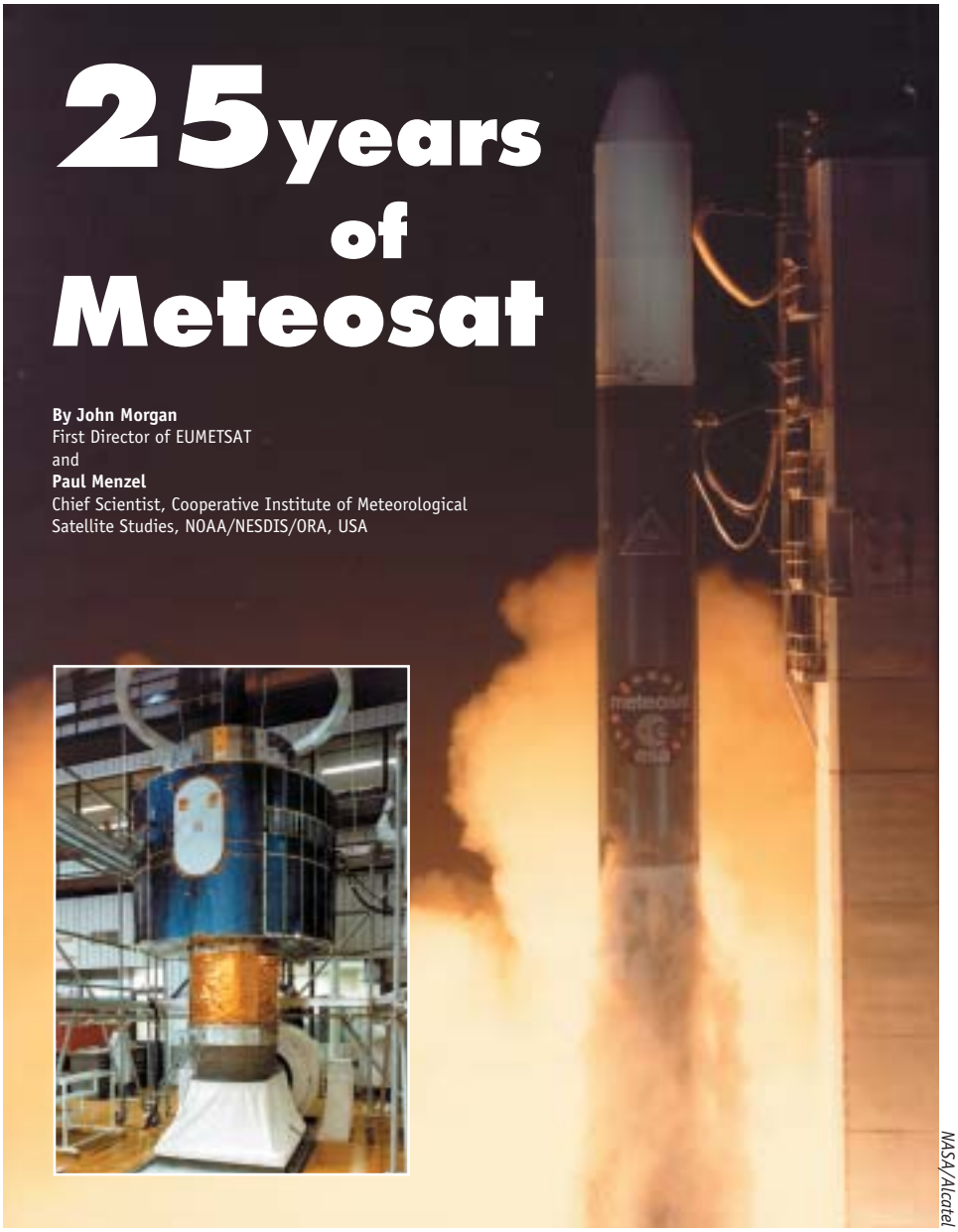
The road to success for MSG has seen some intensive debates in Council meetings but European cooperation always won the day. I wholeheartedly thank our Member States, and staff of the European Space Agency (ESA) and EUMETSAT, the industrial teams who prepared the MSG-1 satellite and last but not least Arianespace for safely delivering it into geostationary transfer orbit.

On the first attempt to launch the satellite there was a large measure of tension when computer problems between the ground system and the launcher put us beyond the launch window. The second attempt 24 hours later was equally tense and exciting. And there was palpable relief as the satellite separated from the rocket.

After 18 days of intensive care by ESA, we now have our baby in orbit at 10.5°W under EUMETSAT control. Once the commissioning that was put on hold on 17 October is resumed we look forward to production of the first image and transmission of image data to users for evaluation.

25 years of Meteosat

By John Morgan
First Director of EUMETSAT
and
Paul Menzel
Chief Scientist, Cooperative Institute of Meteorological Satellite Studies, NOAA/NESDIS/ORA, USA



NASA/Alcatel

Meteosat-1 (inset) in the Alcatel clean room in Cannes, France, and its launch from Cape Canaveral, Florida

ESA

Intergovernmental Conference on Meteosat Operational Programme at ESA headquarters in Paris in January 1981

Over the past 25 years Meteosat has proved an extraordinary success story – owing its success to the vision and long-term cooperation of the European meteorological community, together with the efforts of European industry, the initiative of the European Space Agency (ESA) and the operational continuity assured by EUMETSAT.

The Meteosat satellites have not only provided data over most of the last 25 years but have also been the inspiration for a successor, Meteosat Second Generation (MSG), which will support operational and research activities for the coming decade and more.

The quarter century of Meteosat data started in 1977, when the first in the series was launched by ESA. At that time Meteosat's Visible and InfraRed Imager (MVIRI) had the best infrared resolution, with the largest mirror, of satellites in geostationary orbit, and was the first satellite instrument to introduce time continuous water vapour images.

These new images provided a very different view of the planet Earth, dramatically depicting areas of moist rising air and dry descending air as well as the humidity of the upper troposphere.

There were two primary motivations for the initial Meteosat programme – to provide European meteorologists with a pre-operational resource in order to develop and make use of techniques using geostationary satellites, and to serve as a European contribution to the year-long operational phase of the First GARP (Global Atmospheric Research Programme) Global Experiment (FGGE).

This was the first international experiment to use satellites. A network of five geostationary satellites supported FGGE, with two USA GOES satellites covering the Americas and new satellites from Europe and Japan covering their respective sectors. In a unique example of technical and scientific cooperation a third GOES satellite was moved to cover the Indian Ocean sector, controlled from European facilities in Spain and Germany.

The geostationary satellites immediately proved their relevance to the research activities, with cloud imagery and cloud track winds defining the state and dynamics of the atmosphere. Meteosat's unique water vapour channel provided an even greater density of atmospheric motion winds than the cloud patterns, also providing information on vertical motion in the

atmosphere. In these two respects the new channel was the envy of Verner Suomi, working in Wisconsin and considered by many to be the father of geostationary meteorological satellites, following his work on the SMS, ATS and GOES series of USA satellites.

On the operational side Meteosat became almost immediately a vital resource for the meteorological community. The enthusiasm for this new capability was hardly affected by the failure of Meteosat-1 after two years of operation. Indeed this occurrence encouraged further efforts to define a truly operational and fully funded capability.

The high point was the Intergovernmental Conference, which met in 1981 and again in 1983 in order to define the way forward. This was done through the establishment of EUMETSAT, which came into existence in 1986, and took overall responsibility for the Meteosat programme in 1987.

While use of the new system grew rapidly, Meteosat was also the focus of many areas of international cooperation to improve the utility of meteorological satellites. In an early example of this, the Meteosat system was the recipient of cooperation when the USA made its GOES-4 satellite available to support the failed Data Collection System (DCS) on Meteosat-2.

Several years later, Europe was able to reciprocate this gesture by moving Meteosat-3, first to 50°W and then to 75°W to cover a temporary reduction in the GOES cover from a two-satellite system to a single satellite. This was of particular benefit during the hurricane season, when Meteosat-3 was instrumental in providing early warning of the track of the devastating Hurricane Andrew.

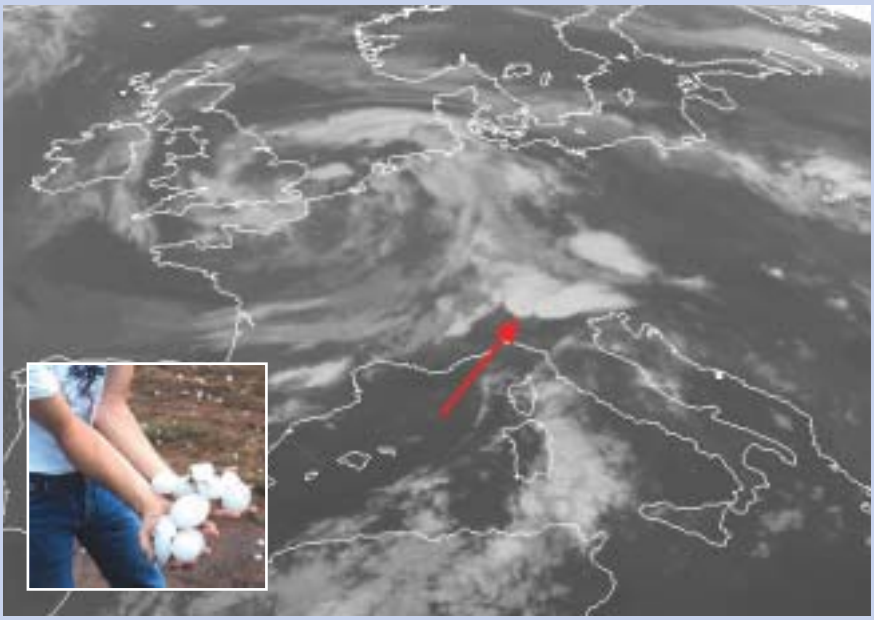
International cooperation in other areas became one of the growing benefits of the Meteosat system. Already by the time EUMETSAT was established there were user stations in more than 50 countries. This later grew to more than 100, helped in part by the parallel growth in electronics and low-cost systems based on the increasingly ubiquitous Personal Computer, and in part by a new facility introduced on Meteosat-4 and later satellites. The new Meteorological Data Distribution (MDD) system rapidly became a primary operational tool in many African countries where conventional communications systems had been unable to provide adequate and reliable access to meteorological data.

In addition to these operational developments, the research communities in Europe and elsewhere have made extensive use of Meteosat data in a wide variety of research fields including meteorology, climate, agriculture, veterinary and the environment generally.

In fact the Meteosat era has seen a huge increase in the research use of satellite data, with many of the lessons learnt in operational meteorology helping to support research in diverse fields. This growing capability has been of fundamental importance in the preparations for MSG, which will become apparent as the new system is brought into full operation.

It has been an exciting 25 years for those involved with the Meteosat system, which has generated millions of images covering three spectral bands. It has formed the bedrock of a successful new international organisation, EUMETSAT, and has helped to demonstrate international cooperation on the widest scale, as well as fulfilling its primary mission in support of Europe's meteorological agencies and their forecasting systems. Today it still provides a complete operational service and serves as a stepping-stone to the major advances to be provided by the second generation.

From the archive



Exceptionally severe hailstorm over northern Italy, 4 August 2002

The Meteosat infrared image above, taken at midnight (UTC) on 4 August 2002, clearly shows an area of deep convection over northern Italy. The resulting storms caused exceptionally severe weather conditions with hailstones up to 700 g in weight, wind gusts of 36.7 m/s and precipitation amounting to 37.8 mm in 20 minutes. More than 30 people were injured by large hailstones and falling objects, and up to 20% of fruit and olive crops and about a third of the wine harvest of the region were destroyed.

The most severe storm of a series developed in the early hours of Sunday, 4 August over the eastern part of the Piedmont region. As it traversed along the Alps it caused severe damage and destroyed a campsite near Lake Garda, seriously injuring many campers. The accompanying photo gives some idea of the exceptional size of the hailstones that fell in the area.

A more extensive exposé of the meteorological situation and some facts and figures on the effects of the storm can be found on our website at the address below.

www.eumetsat.de/en/area5/special/hailstorm_04082002.html

LEOP prepares MSG for work

ESA

The ESOC control centre facilities used for the MSG LEOP

Just as critical as a launch itself is the Launch and Early Orbit Phase (LEOP) of a satellite's life and this was no exception for the first Meteosat Second Generation (MSG-1).

As the advanced weather satellite soared into the skies, activities began at ESOC (European Space Operations Centre) in Darmstadt to ensure it received all the vital instructions needed once the Ariane had placed it into geostationary transfer orbit.

LEOP can vary in length but is always a critical period in the satellite's lifetime and for MSG-1 lasted from launch on 28 August until 6 September. The spacecraft then received instructions to 'drift' towards 10.5°W, its designated orbital slot, where it arrived on 24 September ready for commissioning.

"The major activities were to be a single attitude manoeuvre immediately after separation followed by a series of orbit manoeuvres," said Lothar Schwarz, the EUMETSAT representative at ESOC whose role was to supervise activities and coordinate advice in case of any problems.

MSG-1 was launched with a low spin rate and in an inert state, so LEOP tasks also involved increasing the spin rate to around 55 rpm shortly after separation from the launcher and switching on the instrumentation.

During the liquid apogee boost motor firing some 40 hours into the mission, close monitoring from the ground system detected that the helium tank used to pressurise the fuel had dropped to a much lower temperature than expected.

"To avoid potential problems with the second and longer burn planned for 24 hours later we re-designed the manoeuvre and split it into two separate burns so that each would be shorter," explained Lothar. "It was a challenging, interesting and ultimately very successful phase."

The three burns successfully circularised MSG-1's orbit, initialising the drift to its station position. Once this was confirmed the final task of LEOP was to unlock the SEVERI imaging mirror system and reorientate the spacecraft into an upright position.

"The MSG spacecraft carries a unified propulsion system with liquid-powered engines using the same propellant throughout its in-orbit life," said Lothar.

"The problematic tank and engine have now been isolated from the rest of the system as they will not be required again but the problem with the helium tank is still under investigation as we would like to prevent similar difficulties during the LEOP of MSG-2," he added.

MSG-1 is now in EUMETSAT's hands

After a faultless Launch and Early Orbit Phase (LEOP) performed by the team at ESA/ESOC, MSG-1 was handed over to the EUMETSAT Control Centre on 25 September, where the spacecraft and ground system check-up operations began.

Supported by the ESA/ESTEC and Alcatel spacecraft teams, commissioning phase-A progressed well, focussing on the initial check-up of the spacecraft platform and payload, and the supporting ground segment facilities.

The commissioning was temporarily put on hold on 17 October while an unexpected shut-down of a solid state power amplifier on board MSG is carefully investigated.

Although there are four such units, one providing redundancy, the condition is being subjected to in-depth investigation to ensure that commissioning can be resumed in the safest mode possible.

On resumption of commissioning, the stage is set for the initialisation of the SEVIRI (Spinning Enhanced Visible and Infrared Imager).

Capturing the first images starts with the visible channels only, then incrementally building up to the full SEVIRI detector configuration lasting between four and six weeks. Completion of these tests will mark the end of commissioning phase-A.

The operational dissemination trials will then follow, involving the incremental build-up of the contents of the High and Low Rate Information Transmission (HRIT and LRIT) dissemination channels.

This is aimed at serving two purposes – to tune the MSG ground system to support an operational dissemination scheme, and to allow the users to set up their reception systems and to have early access to MSG data.

Notification of the resumption of the commissioning and further information will be provided on the EUMETSAT website.

image profile

Sergio Rota

Head of the Geostationary Satellite Programme Division

Sergio Rota, Head of the Geostationary Satellite Programme Division

As the Head of EUMETSAT's Geostationary Satellite Programme Division, Sergio Rota, with over 20 years' experience in the aerospace industry, is more than qualified to oversee the way this new weather satellite will deliver valuable data.

Having joined EUMETSAT almost five years ago on 1 January 1998, Sergio is responsible for the implementation of meteorological geostationary systems and, in particular, the development and implementation of the Meteosat Second Generation (MSG) programme.

Gaining a university degree in Mechanical Engineering at the Politecnico di Torino in 1980 provided Sergio with a sound basis for his career in the European space industry which started in the Project Control Department at Aeritalia Gruppo Sistemi Spaziali (now Alenia Spazio).

In 1983, Sergio joined Matra Espace (now Astrium) at Toulouse where he was Project Controller and Assistant Programme Manager for Alenia on the science satellite Hipparcos.

Moving on to the Columbus programme, the manned laboratory of the International Space Station (ISS), allowed Sergio to manage, during the feasibility phases of the various programme elements, the complete subcontractors' consortium for the attached pressurised laboratory of the ISS.

Whilst working on Columbus, Sergio also supported the definition phase of the ISS pressurised logistic module built for NASA through the Italian Space Agency.

In 1992 Sergio relocated to Rome and established the 'Programme Planning and Control' function for the recently merged Alenia. A year later he returned to Turin as Alenia's Programme Manager for Columbus. With a team of over 80 employees, he was appointed Head of Programme Planning and Control Function for Alenia Spazio Turin which involved schedule, cost planning and control, and configuration management and data management for the manned infrastructures and scientific satellite business unit.

For the future, the successful production and completion of MSG-2 and 3 are high on his priority list. He is striving to fully satisfy the expectations of the user community and, in parallel, will actively contribute to the definition process of future geostationary missions.

Sergio is married and has a five-year-old daughter. He enjoys playing the piano.

A glimpse behind the scenes of the MSG launch

Notes from the diary of EUMETSAT engineer Harald Konstanski

"Taking my position in the Jupiter Control Room on 28 August 2002, just ten hours before the launch of MSG-1, the final countdown starts for a second time. Hopes are high despite yesterday's failed attempt but that's been resolved and I now resume my duties as the interface with the ESOC Ground Segment, checking out the voice links between Kourou and ESOC.

"With this, the activation of the satellite starts. Subsystems are switched on until the spacecraft is in its launch configuration. Eight hours to go and every subsystem of MSG-1 is green.

"We edge towards the final countdown. Three hours and 34 minutes to go, the large tanks of the Ariane-5 rocket are filled with liquid oxygen and liquid hydrogen. The atmosphere tightens as more people enter the control centre.

"With just under one hour to go, the control centre is full of personnel and the tension palpable. Barely distracted by the visitors, I concentrate on the last checks of spacecraft telemetry. Everything is still green.

"The launcher? Our co-passenger satellite? Both green. Another check with ESOC, and their times are synchronised with the countdown.

"Time is flying now. At 20 minutes before launch, MSG-1 switches from external power to internal batteries. Seven minutes. The automated sequence starts, all control is now with the computers. I do a last synchronisation and voice check with ESOC, the satellite parameters are still ok and we give the 'Go' for the final activities.

"Then, with just five minutes to go, the launcher is set to red and the countdown stopped and re-set to seven minutes. It's been put on hold for failure investigation! Please, not a repetition of yesterday…

"As we hold our breath, Arianespace immediately informs us about the nature of the problem – a wrong reading of a parameter in a supply line. At 19 hrs 8 min 10 sec local time in Kourou the countdown is resumed. Seven minutes to go.

"Last check of spacecraft, last synchronisation with ESOC…cinq, quatre, trois, deux, un…main engine ignition. I see on the screen the Vulcain engine igniting and emitting a stable tail of fire. Seven seconds later the mighty solid boosters ignite and are pushing the launch vehicle off its launch table. Lift-off!

"As the Ariane and its payload satellites head into the tropical skies, things are no longer in our control. I become a passive observer, passing automated data to my colleagues in ESOC. Solid booster separation, fairing separation, second stage burn. It is a story book launch.

"The ground station in Malindi acquires a signal. ESOC reports to me that they can already see satellite telemetry though the satellite is still fixed to the launcher. And then, some minutes later, the final release – successful separation of MSG-1 from the launcher into an excellent orbit and perfect attitude. What a relief! The tension evaporates and we finally relax, clapping hands, congratulating, smiling, laughing – relieved and simply happy."

Hi-tech meeting in Dublin Castle

The historic Dublin Castle was the venue in the first week of September for 190 meteorological satellite experts from 32 countries who gathered to hear about and discuss the latest in satellite systems and new processing applications.

Over 70 speakers gave presentations in the plenary sessions while over 50 poster displays and software demonstrations kept participants interested throughout the week.

The EUMETSAT Satellite Conference was co-organised and hosted by Met Éireann. New on the agenda this year were items on ocean observation, training applications and the use of radio navigation signals for meteorological purposes. Work is well advanced on the proceedings of the conference with distribution planned by the end of the year.

The next in the series of conferences will be held in conjunction with the Deutscher Wetterdienst, in Weimar, Germany, between 28 September and 3 October 2003.

CGMS meeting

International representatives of all the major meteorological satellite operators – known as the Coordination Group for Meteorological Satellites (CGMS) – convened in Bangalore (India) on 11-15 November 2002.

Experts from China, India, Japan, Russia and the USA met with representatives of EUMETSAT, the World Meteorological Organization and the International Oceanographic Commission of UNESCO to discuss and formulate plans on matters of common interest, related to observing the planet from space.

Global satellite update

Europe: Meteosat-7 supports the primary service at 0° Longitude. Meteosat-6 performs the operational Rapid Scanning Service (and is the primary service back-up at 10°E). Meteosat-5 continues the Indian Ocean Data Coverage Service at 63°E. MSG-1 was launched on 28 August, 2002 and is currently undergoing commissioning. MSG-2 is currently planned for launch in January 2005 and Metop-1 in mid-2005.

USA: GOES-8 (East) is functioning at 75°W. GOES-12 is scheduled to replace GOES-8 as the GOES East operational spacecraft on 31 March 2003. GOES-9 is expected to act as back-up for the Japanese GMS-5 from Spring 2003. GOES-10 (West) is functioning at 135°W. GOES-11 acts as back-up at 105°W. On 1 October 2002 NOAA-17 was declared the primary polar orbiting morning satellite. NOAA-15 is the backup satellite. NOAA-16 is the primary polar satellite in the afternoon orbit with NOAA-14 as the backup.

Russia: Meteor-3M-N1 was successfully launched on 10 December 2001 into a polar sun-synchronous morning orbit, inclined at 99.7°. Meteor-3M-N2 is planned to be launched in 2005. GOMS-Electro-N2, which will be positioned at 76°E, is planned for launch in 2005. One satellite of the Meteor-3 series continues to operate beyond its designed lifetime with reduced capabilities in circular orbits inclined at approximately 82°.

China: Fengyun-1D (FY-1D), a polar-orbiting meteorological satellite to replace FY-1C, launched on 15 May, is fully operational. FY-2B is stationed at 105°E. FY-2A continues to act as back-up satellite at 86°E. FY-2C is planned for launch at the end of 2003 and will replace FY-2B. FY-3A, the first of the second generation of Chinese polar orbiting meteorological satellites, is planned for launch in 2004.

Japan: GMS-5, Japan's current operational geostationary meteorological satellite, continues to operate at 140°E. The US satellite GOES-9 is expected to act as back-up for GMS-5 at 155°E from Spring 2003 until MTSAT-1R becomes operational towards the end of 2003. MTSAT-1R is scheduled to be launched in the summer of 2003. MTSAT-2 will be launched in the summer of 2004.

India: METSAT, India's first exclusive meteorological satellite, was launched on 12 September 2002 and is positioned at 74°E, collocated with INSAT-3C. INSAT-2B and INSAT-2C are collocated at 93.5°E. INSAT-2DT is positioned at 55°E, INSAT-2E at 83°E. INSAT-3A is scheduled for launch in December 2002, INSAT-3D and -3E launches are planned in the 2003-2005 time-frame. INSAT-1D was deactivated on 14 May 2002.