promisse mission

→ INFORMATION KIT

European Space Agency

promisse mission

→ INFORMATION KIT

→ MISSION OVERVIEW

A fully assembled and operational International Space Station (ISS) will welcome ESA astronaut André Kuipers at Christmas time in the fourth European long-duration mission to the orbital outpost.

André enjoying microgravity on the Space Station during his previous mission

André is scheduled to be launched on 21 December from the Baikonur Cosmodrome, in Kazakhstan, on a Soyuz spacecraft as flight engineer for Expeditions 30 and 31, together with Russian cosmonaut Oleg Kononenko and NASA astronaut Don Pettit. They will remain in space for nearly five months as part of the international six-astronaut resident crew.

PromISSe is the first long-duration mission for a European following the end of the Shuttle programme in July 2011. With the ISS lifetime extended to 2020, André's presence on the Space Station inaugurates a new decade of bringing the benefits of space science, technology and education back to Earth.

This will be André's second visit to the ISS, following his 11-day Delta mission sponsored by the Dutch government in April 2004. Back then he was also launched on a Soyuz rocket. "It feels like going back home, but the house will have doubled its size since my last visit," says André. During Delta, the Space Station had only four main modules (Zarya, Unity, Destiny and Zvezda) and two resident crewmembers.

André will be the first Dutchman to make two spaceflights. "I remember how thin Earth's atmosphere looks like from space and how black the Universe is. It made me realize that billions of people live in a very fragile planet. We really should take care of it," recalls André.

The transition from ISS assembly to full operations gives a boost to scientific research. With less time spent on assembly tasks, the crew hours available for science during PromISSe will be significantly increased. "We have a pretty busy schedule. We will be conducting scientific experiments around 40 hours per week," says the astronaut.

André is a medical doctor who has been actively involved in microgravity research for more than ten years. "The data I will collect from my own body can

KEY DATA

Mission	Expedition 30/31 to the ISS
Launch site	Baikonur, Kazakhstan
Launch date *(Status as of mid Nov)*	21 Dec 2011, 13:16 GMT/14:16 CET *21 Dec 2011, 19:16 (local time)*
Docking	23 Dec, 13:43 GMT/14:43 CET
Landing	16 May 2012
Launch / landing craft	Soyuz 29S (TMA-3M)
Launcher	Soyuz FG
Crew	Oleg Kononenko, Soyuz and Expedition 31 Commander André Kuipers, flight engineer Don Pettit, flight engineer
Mission duration	148 days

bring valuable information about the effects of weightlessness on the human body. This research may help in preparation for a future mission to Mars," he posted on his blog.

During the 148-day mission he will take part in around 30 ESA experiments covering a range of disciplines: human research, fluid physics, materials science, radiation and solar research, biology and technology demonstrations. Most of them will be carried out in Europe's Columbus laboratory, a world-class research platform. André will celebrate the fourth anniversary of this European laboratory module while in orbit.

Countermeasures for bone loss, the study of headaches in space and mapping the radiation environment inside the Station are among the experiments related to human exploration. André will not only perform experiments for ESA, but also more than 20 for the US and Japanese space agencies which require the use of almost 30 different research facilities in the various ISS laboratories.

As flight engineer on the Station, André will have several assignments, ranging from system aspects to payload operations. He will be on hand for processing of visiting vehicles. He will be the prime crewmember for the rendezvous and docking operations of ESA's third Automated Transfer Vehicle, *Edoardo Amaldi* (ATV-3).

Soyuz ready for liftoff for André's mission in 2004

The largest servicing vehicle for the Station available today will deliver essential cargo, perform regular ISS orbit reboosts and attitude control manoeuvres. It will enable debris-avoidance manoeuvres for the whole complex if needed.

André will be highly involved in berthing the new visiting vehicles Dragon (SpaceX) and Cygnus (Orbital Sciences) as part of NASA's commercial resupply programme.

André will have his eyes on our planet. He will share some of the unique views of Earth from the Station's Cupola and invite children to become involved in a wide range of educational activities. Space is the exciting platform chosen for primary and secondary pupils to learn, together with the astronaut, about life, biodiversity and climate change on Earth.

Science activities will be transmitted from space to classrooms across Europe with in-orbit demonstrations of experiments on convection and wet foam formation. André is also an advocate for health and human well-being. He will encourage the new generation of space explorers to stay fit by following the second edition of the international education initiative Mission X: Train Like an Astronaut.

→ MISSION LOGO AND NAME

The logo

A colourful and lively logo has been created for the PromISSe mission. The mission name crowns a circular design belted with orange cords, while the International Space Station acronym stands out in the same colour to bring out the Dutch participation in the mission.

A silhouette of the ISS is shown orbiting above Earth. Its flight path is about to overfly the European continent, a reference to Europe's contribution to human spaceflight. The six stars represent the six crewmembers and, as the stars are similar to those on the EU flag, the European character.

The core of the logo is an Earth globe without any borders and day–night contrast. Our special correspondent in space will take pictures of the unique views from the Station's Cupola. He is especially looking forward to sharing night shots.

The icons on the left represent the mission's three crucial elements: science, technology and education. The globe stands for a knowledge-based society focused on our planet. The electronic circuit denotes technology. The conical laboratory flask illustrates scientific research.

Our Earth ambassador in space wants the PromISSe mission to be a shared adventure. As a teamplayer, André chose not to have his name on it and make this logo as universal as possible.

The name

André's mission is called **PromISSe**, reflecting the great expectations placed on the future of human spaceflight and exploration. Following the trend of four previous European missions, the acronym of the International Space Station is part of the name.

The competition was open only to citizens from ESA member states, but the call for ideas surprisingly attracted a lot of attention in other countries. People from Slovenia, Australia, India, Mexico and Argentina also wanted to take part in André's mission. He will be our Earth Ambassador in space.

That the selected name came from a compatriot of André was not by chance, as most of the ideas received by ESA in response to a public, online competition, were from the Netherlands.

Wim Holwerda, a 61-year-old Dutchman, believes that his winning proposal "symbolises the promise space exploration poses to the future of our planet and humankind, as well as the role Europe can play in it."

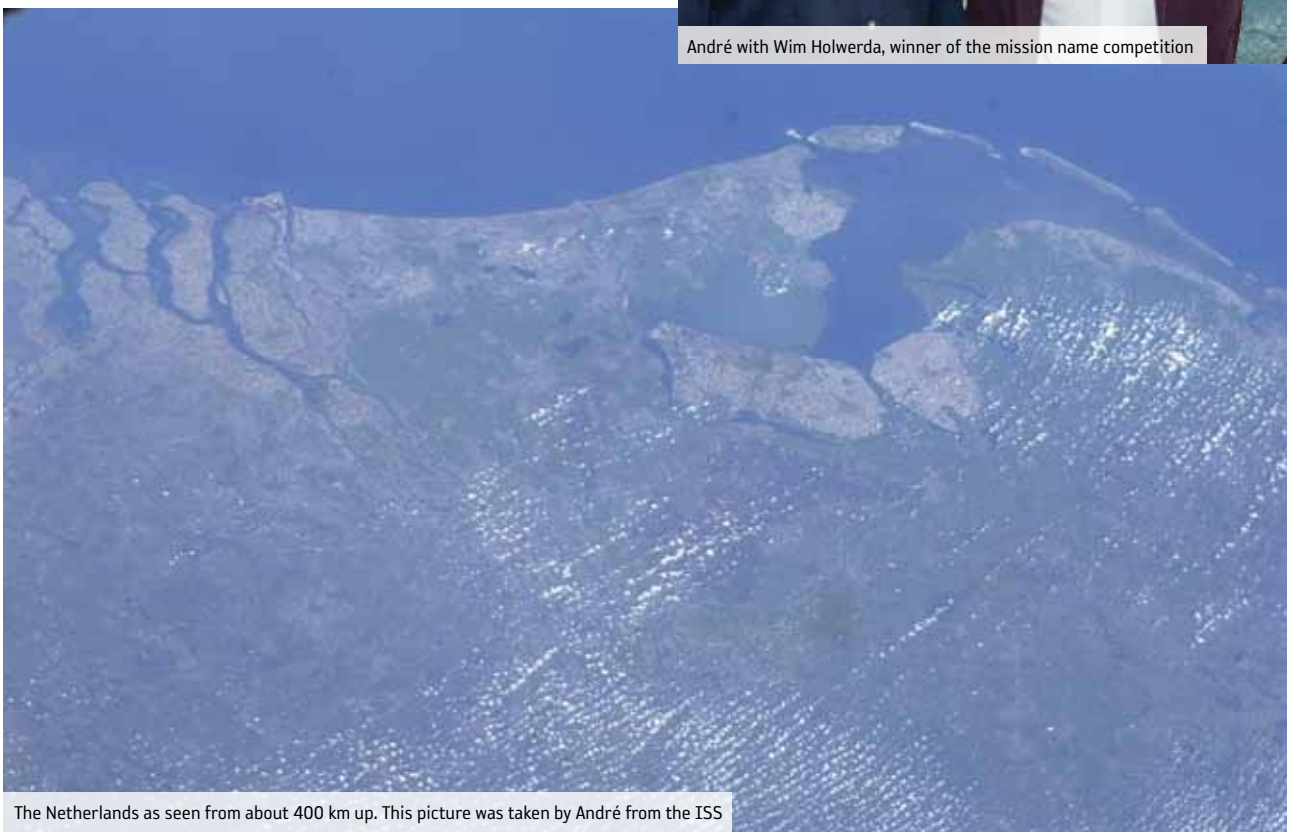
The name and acronym proposed by Wim stands for **P**rogramme for **R**esearch in **O**rbit **M**aximising the **I**nspiration from **S**pace **S**tation for **E**urope.

Three powerful messages shared by the European Space Agency are also integrated in PromISSe: the crucial role of scientific research, a greater use of the Space Station and the inspirational value of ESA space programmes.

André Kuipers called on Europe's citizens to propose names for his mission last June. ESA received more than 200 proposals in just one month, and their ingenuity made the final selection a tough challenge.

Creative mission names came from all over Europe and from all ages. The ideas of a 13-year-old Italian competed with those from a Dutchman aged 82. Some proposals included logos and marketing initiatives.

André with Wim Holwerda, winner of the mission name competition



The Netherlands as seen from about 400 km up. This picture was taken by André from the ISS

→ ANDRÉ KUIPERS

Checking communications interface inside a Space Station module during training

Tasks in space

ESA astronaut André Kuipers was assigned to the PromISSe mission in 2009. After arriving at the International Space Station he will take up his tasks as a flight engineer and resident crewmember. A great multitasker and teamplayer, André will be busy with varied duties from the outset of his flight.

- André will fly on the left side of the three-seat Soyuz capsule, a seat traditionally assigned to European astronauts serving as flight engineer. In this Soyuz role he will be the 'right hand' of the Soyuz commander, Oleg Kononenko, during the ascent and descent phases.

- André will be the prime operator for the ATV *Edoardo Amaldi* rendezvous and docking. Although the spacecraft docks automatically with the ISS, he will monitor and be ready to take over control if needed. Once it is attached to the Station, he will be in charge of logistics operations on the vehicle.

- André will support complex robotic operations. He is trained in the Space Station Remote Manipulator System (the Station's principal robotic arm).

- André is closely involved in the berthing operations of the visiting Dragon and Cygnus cargo vehicles during their maiden flights to the Station.

- André, as a medical doctor himself, is trained as a crew medical officer. In this function he can support the flight surgeon and medical team on the ground, in case of medical issues on board.

- André is fully trained to perform a possible Extra Vehicular Activity (EVA). This means that, if needed, he could perform a spacewalk outside the ISS.

Training for emergencies in one of the Soyuz simulators in Star City, Russia

Training

Over the last two and half years, André has been travelling between the training sites of all five ISS partner organisations, gaining the knowledge and skills required for his mission. This tailored training has taken him to Houston in the US, Star City near Moscow, Tsukuba near Tokyo, Montreal in Canada and the European Astronaut Centre in Cologne, Germany.

Roughly half of his training has taken place in Star City. André has spent approximately the other 40% of those 30 months in the US, and the remaining 10% divided between the European Astronaut Centre and the facilities of the Japanese and Canadian space agencies. More than 50 people have been taking care of André's training programme from across all establishments.

André has already flown in the left seat in the Soyuz for his previous mission in 2004. Since then, he has gained a much better operational understanding of what is really important for daily life on the ISS.

He has mastered every system and payload related to the PromISSe mission. Simulations have helped André to get ready for space. His role as Soyuz flight engineer requires a great amount of 'flying hours' within the Russian spacecraft. The 53-year-old astronaut speaks fluent Russian, a key asset in case of an emergency on the Soyuz.

André is a highly skilled astronaut with an advanced training level that enables him to face all kinds of emergency situations, prolonged isolation and psychological stress. Specialised trainers taught him critical launch and landing procedures on the Soyuz, as well as how to handle depressurisation, fire or toxic spills onboard. This kind of training started on the ground, but it will continue once he gets to the Station with the rest of the crew.

He is not only trained for critical decision-making: André knows how to run all the experiments he is involved in. The 'doctor aboard' will provide continuous feedback about his health and the medical experiments where he is test subject. On the Station, André will often take samples of his blood, check his heart beat and monitor his eyes.

André training for spacewalks at NASA's Johnson Space Center

André is fully trained to perform a possible Extra Vehicular Activity (EVA)

EVA training with Frank De Winne at Houston in 2007

Training includes how to handle depressurisation, fire or toxic spills on board

Training in the Soyuz mock-up at Star City

Spaceflight experience

Russian spacecraft, experiencing weightlessness and living in the core modules of the International Space Station are nothing new to André. PromISSe is his second opportunity to work in orbit, this time on a much longer mission.

André performed the 11-day Delta mission in April 2004. He was assigned then as flight engineer for a Soyuz flight sponsored by the Dutch government. The mission was important from logistics aspect: it made possible the rotation of ISS crew and Soyuz capsules, which serve as the Station's crew lifeboats.

During Delta mission André performed more than 20 experiments and demonstrations in human physiology, biology, material science, technology and education.

André also served as backup to ESA astronauts Pedro Duque for the Cervantes mission in 2003 and Frank De Winne for the OasISS long-duration mission in 2009. He is familiar with microgravity conditions thanks also to his participation in several parabolic flight campaigns, where he was active in testing instruments for human physiology research.

Sharing his trip

André Kuipers is eager to share his many experiences, sunrises and sunsets flying at around 350 kilometres above our heads. Last summer he launched a dedicated blog in Dutch, a good way to track him during the final stages of his training on planet Earth.

Following the latest social media trends, André also started tweeting half a year ago and he will continue to do so from orbit. He adds photos to his tweets every now and then.

Our special European correspondent will stay in touch with the ground not only via Twitter, but also via his own blog, ESA YouTube and Flickr channels.

Everything but the routine directly from space.

ESA's PromISSe website
www.esa.int/promisse

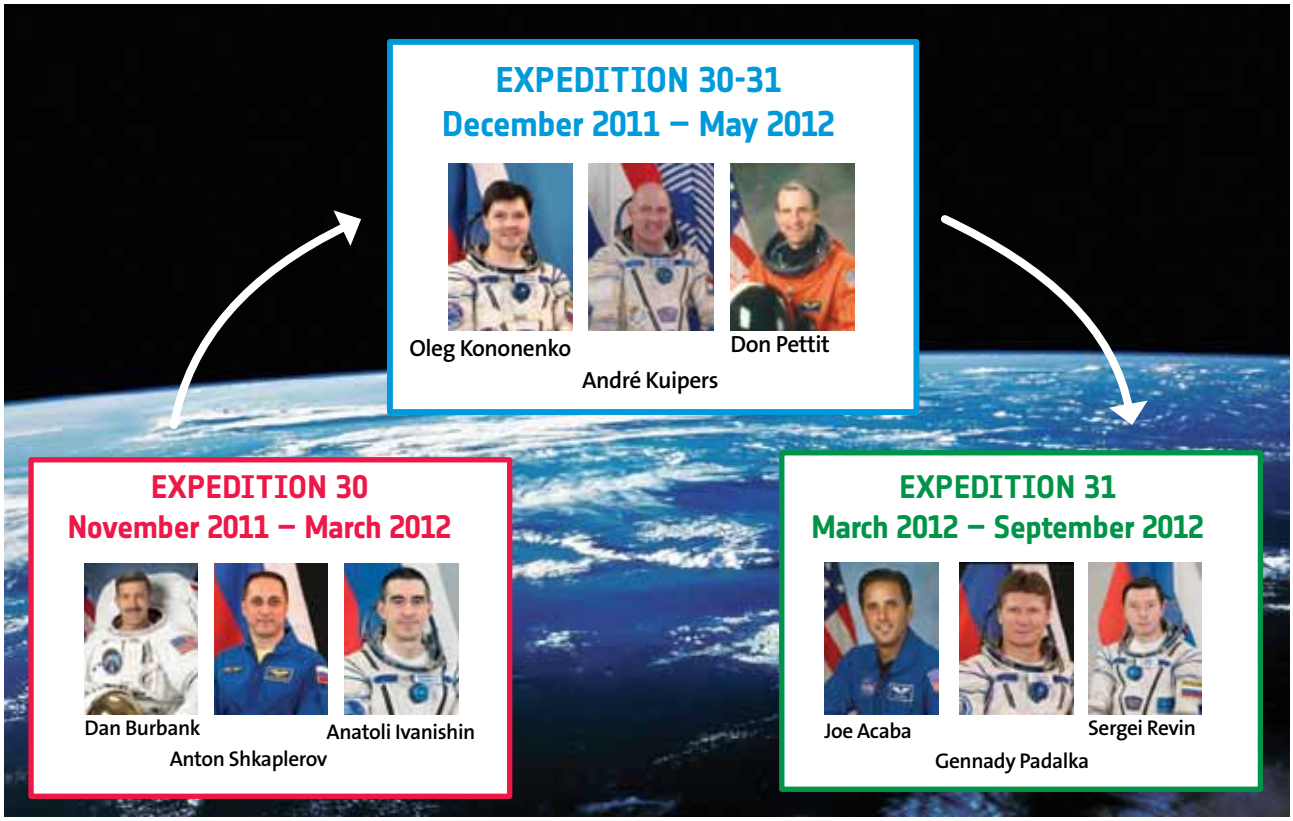
Twitter
@astro_andre

ESA's YouTube channel
www.youtube.com/ESA

ESA's Flickr account
www.flickr.com/europeanspaceagency

Blog (in Dutch)
www.andrekuipers.nl

→ THE CREW



EXPEDITION 30 AND 31

ANDRÉ KUIPERS

- Soyuz TMA-3M crewmember
- Expeditions 30 and 31 flight engineer

André Kuipers' ambition to be an astronaut began early in life, but it wasn't until he became a doctor that he saw a way to combine his professional career with his interest in space exploration. Inspired by the idea of helping mankind to travel further in space, his research into human adaptation to space led him to the European Space Agency.

Before becoming an ESA astronaut in 1999, he got involved in aviation and space medicine. He participated in research projects on space adaptation syndrome, contact lenses for pilots, spatial disorientation, blood pressure and cerebral blood flow in both a centrifuge and in weightless conditions in aeroplanes. He was project scientist for experiments flying on the Mir space station and the Shuttle during a Spacelab mission.

During two Soyuz missions to the International Space Station involving other ESA astronauts, he acted as Crew Interface Coordinator from the Russian control centre, TsUP, in Korolev, near Moscow.

André also qualified as a 'Eurocom', the crew communicator at the European Astronaut Centre in Cologne, Germany, and the Columbus Control Centre situated at the German Aerospace Center (DLR) facility in Oberpfaffenhofen, near Munich. André will be 53 when he arrives at the ISS for the second time. He has proved to be a great teamplayer, an active person and an experienced astronaut with a high interest in robotic activities and human physiology research. His Russian language skills are remarkable. As ambassador of the World Wildlife Fund, his PromISSe mission also aims at exploring better ways to take care of the equilibrium between Earth and its inhabitants.

OLEG KONONENKO

- Soyuz TMA-3M and Expedition 31 commander
- Expedition 30 flight engineer

Oleg Kononenko is the Expedition 30 crewmember with the most days logged in space: 199. He is 47 years old, making him the youngest aboard the Soyuz TMA-3M.

He started his career in space as an engineer at the Central Design Bureau in Samara. At the age of 34, he began training as part of the group of cosmonauts selected for the International Space Station programme.

Kononenko performed two spacewalks during his first spaceflight in 2008. He spent more than 12 hours in space to outfit the Station's exterior, including the installation of a docking target on the Zvezda service module.

The maiden flight of the ATV, *Jules Verne*, took place during that mission and now he will assist André Kuipers during the docking manoeuvres of ATV *Edoardo Amaldi*.

DON PETTIT

- Soyuz TMA-3M crewmember
- Expeditions 30 and 31 flight engineer

Don Pettit was in the middle of doing a fumarole gas sampling on a scientific expedition in New Zealand when he got a phone call from NASA to become an astronaut. He has a doctorate in chemical engineering and was also involved in projects about fluid physics under reduced gravity conditions.

A veteran of two spaceflights, Dr Pettit has logged 177 days in space and over 13 hours on EVAs. During his first long-duration mission in 2002 he was launched on the Space Shuttle Endeavour, but returned to Earth in a Soyuz capsule. Highlights of his second mission in 2008 include expanding the living quarters of the Space Station to house six crewmembers.

"When I return this time to the International Space Station, it's going to be like I'm going home – a home away from home," says Pettit.

From left: Don Pettit, Oleg Kononenko and André Kuipers. They will work together on the Station for nearly five months

EXPEDITION 30

DAN BURBANK
Expedition 30
commander

Dan Burbank has a strong expertise in naval flight training. He has logged over 4000 flight hours, primarily in coast guard helicopters, and has flown more than 300 search and rescue missions.
Dan has served as spacecraft communicator (CapCom) for Space Shuttle and ISS missions. Having flown twice as a mission specialist on the Shuttle in 2000 and 2006, he has logged over 23 days in space.

ANTON SHKAPLEROV
Expedition 30
flight engineer

39-year-old Anton Shkaplerov is the youngest crewmember of Expeditions 30 and 31. He has a long career as a pilot-instructor in the Russian Air Force. He flew different types of aircraft and he is an experienced parachutist.
Born in Sevastopol, Ukraine, Anton was selected as a test-cosmonaut candidate in 2003. Four years ago he served as Director of Operations for the Russian Space Agency at the Johnson Space Center in Houston, US.

ANATOLI IVANISHIN
Expedition 30
flight engineer

This is the first spaceflight for Anatoli Ivanishin. Since 1991 he has served in combat units of the Russian Air Force, becoming a senior fighter pilot. Jet fighters and parachuting have been a major part of his military career.
Like Anton, he was selected as a test-cosmonaut candidate in 2003. He obtained his official qualification two years later.

EXPEDITION 31

JOE ACABA
Expedition 31
flight engineer

Joseph Michael 'Joe' Acaba certainly has an unusual background. He is an educator and a hydrogeologist, but is also the first person of Puerto Rican origin to become a NASA astronaut.
Joe joined the ISS hardware integration team working on ESA equipment. He was assigned to the STS-119 Shuttle mission in 2009, which delivered the final set of solar arrays to the Space Station.
The astronaut performed two spacewalks, logging almost 13 hours of EVA.

GENNADY PADALKA
Expedition 31
flight engineer

Gennady Padalka will be the most experienced space flyer onboard. He ranks sixth for career time in space through his missions on the Mir orbital complex and the International Space Station.
The 53-year-old cosmonaut has logged 585 days in space and participated in eight spacewalks. This will be the third time he flies to the Space Station.

SERGEI REVIN
Expedition 31
flight engineer

Expedition 31 flight engineer Sergei Revin has persevered in making his first flight into space. After 13 years of training and work for the ISS programme, Sergei got a place for Expeditions 31/32.
An engineer specialising in electronics, he was certified as an RSC Energia cosmonaut in 2010.

→ BEHIND THE SCENES

André Kuipers does not travel alone. There are thousands of people who work behind the scenes to make the mission a success. There is a whole team at ESA taking care of every detail.

HEALTH

- **Volker Damann**
  Head of the Crew Medical Support Office

"We have a very close and trusting relationship with André. A whole team of fitness experts, physiotherapists, sport scientists and nutritionists takes care of the astronaut's health, from his mission assignment to his retirement. You can compare us with a football team: we have a coach, a physiotherapist, a psychologist...

Fortunately, we haven't yet had any serious medical incident on the Space Station, but André needs to know what the first aid kits on the ISS and Soyuz look like, where he can find certain medications and what are the medical procedures he should follow, usually different from those he learnt during his medical career.

During the flight we prescribe him two hours of exercise per day to counteract significant bone loss. Once back on Earth, we will tailor his fitness programme on a very individual basis."

TRAINING

- **Hans Bolender**
  Head of the Astronaut Training Division

"We are probably the 'most hated' unit by the astronauts: for those two and half years of training, we schedule 85% of their lives.

More than 50 people have been supporting André's training programme during the 30 months prior to the flight, always trying to integrate the demands of the ISS partners, ESA and the astronaut's own interests.

For his second time in space, André has undergone an experienced training flow. We have trained him in quite a number of emergency situations, not only about launch and landing procedures, but also about depressurisation, fire events or toxic spills on the Station.

I personally enjoy developing new training concepts in a very international environment. At the European Astronaut Centre alone we have 16 different nationalities."

MISSION DIRECTORS

- **Claudio Sollazzo**
  Expedition 30

"Our task on Earth is to allow the astronaut to do his job properly.

Whenever there is a European astronaut onboard, ESA has high expectations. We work to make sure that André can support all the ISS and Columbus activities required during his mission.

We lay out his tasks day by day, I would even say almost hour by hour. However, it is a very dynamic process. The international partners are also involved, so we need to find a consensus. Understanding priorities is key for our job.

I come from an experience of more than 20 years in robotic missions, so I'm used to objects that don't talk to me. I'm really very excited about the human presence onboard. I look forward to working with André Kuipers, in particular because we can interact at a completely different level, adapting, adjusting things on the run."

- **Berti Meisinger**
  Expedition 31

"We are always in the front line at the Columbus Control Centre in Oberpfaffenhofen, Germany.
Operations usually go according to plan, but sometimes unexpected events can take place during the mission. Luckily, we have only had false alarms on the Space Station so far. Fire and depressurisation alarms were activated in the past due to faulty equipment. Nearby space debris is also critical. When it comes close, the whole Station needs to be reconfigured and the astronauts have to be alerted. In extreme cases, they are told to take shelter in the Russian Soyuz spacecraft.
There are often other events that don't affect the astronauts' well being, but might lead to loss of data, communication disruptions or changes in the experiments.
I'm thankful to have such a fantastic and exciting job. We never stop learning!"

LAST STOP: RUSSIA

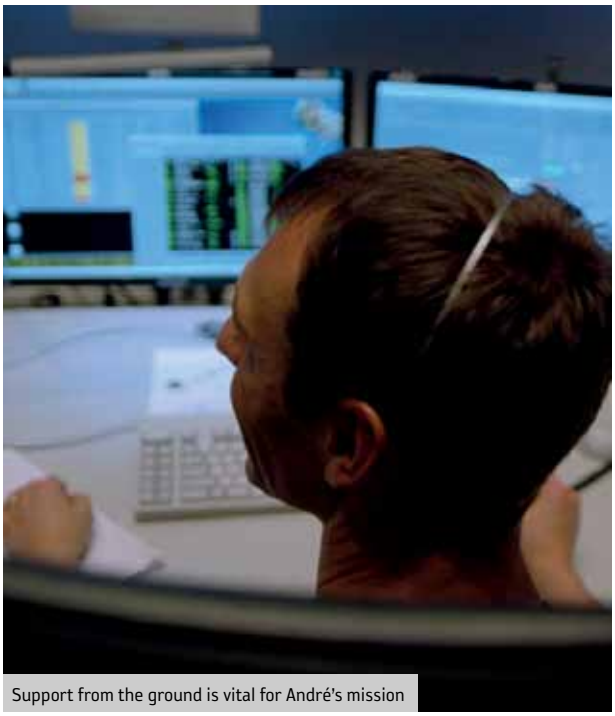
- **René Pischel**
  Head of the Moscow Office

"We are supporting every European mission here in Russia. We are the link between our ESA colleagues and the Russian organisations, but we also act as the liaison with NASA whenever there is a mission to the Space Station. The ESA Moscow office assists with the full range of logistics, from visa to accommodation.
I think I have gone through almost all the traditions that the Russians follow before and after a mission. And, of course, speaking Russian helps a lot to understand the ritual! They are quite superstitious. From the tea ceremony at Roscosmos to the last days of quarantine, everything follows a ritual that started 50 years ago.
It is really rewarding to see how cosmonauts and astronauts form together a big family – it makes no difference from which space agency they come. The atmosphere is just very nice."

SCIENCE

- **Hilde Stenuit**
  Mission Science Office

"We are the voice of the science team within ESA during the PromISSe mission. A year and a half ago, we started to select the set of experiments André will carry out.
The very busy days for us will come as soon as André gets on board. We will always be ready on console whenever André does a science experiment for ESA. Our role is to make sure that everything is going ahead as we hoped it would from a scientific perspective.
Sitting on console is the most critical part of our job. From there we might have to make a quick decision on the spot, in close coordination with the mission directors and the User Support and Operations Centre. Or André may have a question, something can go wrong...
I love working for André's mission. When he is talking about science, you can feel that he is very committed to it, that it really comes from his heart."



Support from the ground is vital for André's mission

→ COUNTDOWN AND LIFTOFF FROM BAIKONUR

ESA astronaut André Kuipers will share a ride with his crewmates Oleg Kononenko and Don Pettit in a Soyuz TMA-M spacecraft. The capsule will be boosted into space on a Soyuz FG rocket from the Baikonur Cosmodrome in Kazakhstan.

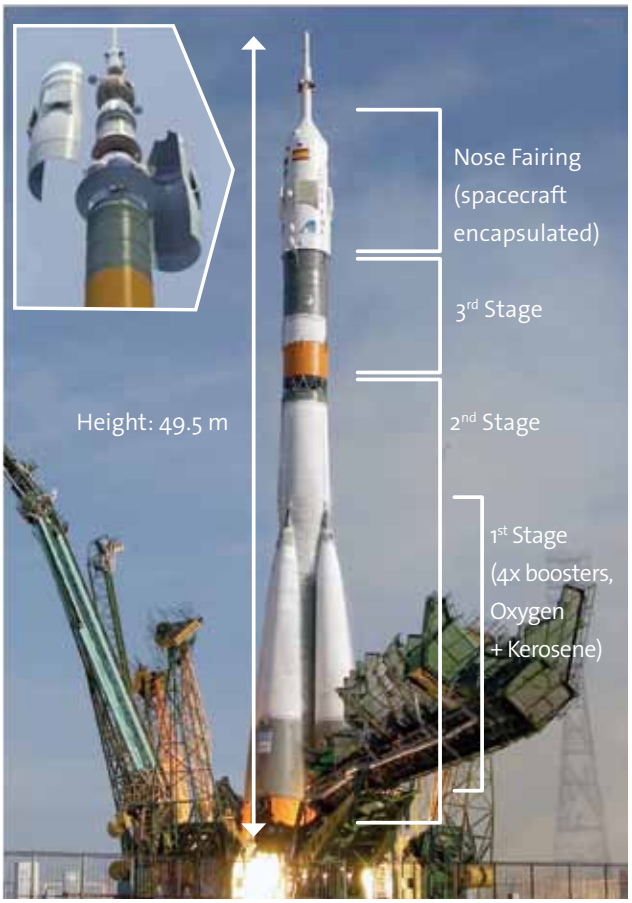
The launch will take place during the night, just one hour after sunset, from the Gagarin pad, the same site that launched the first human into space half a century ago.

"I have to assist commander Oleg Kononenko from the left seat when approaching the ISS. I really enjoy manoeuvring the capsule together and docking smoothly with the Station. Even during the simulations, my heart beats faster and I feel my adrenaline rising," says André.

Soyuz rockets are the longest-serving route to space. The design goes back to the Vostok launcher, which was used for the first manned spaceflight in 1961 to carry the Russian cosmonaut Yuri Gagarin.

André will be launched into space for the second time on a Soyuz rocket

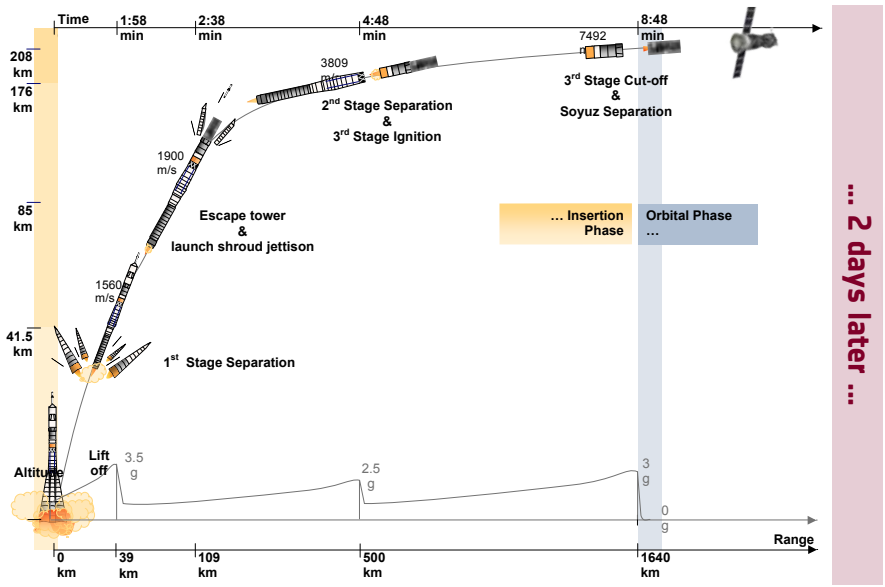
Soyuz-FG Launcher characteristics



- Diameter: 10.3 m
- Total launch mass: 310 t
- Payload: 7150 kg
- Propellant mass: 157 t

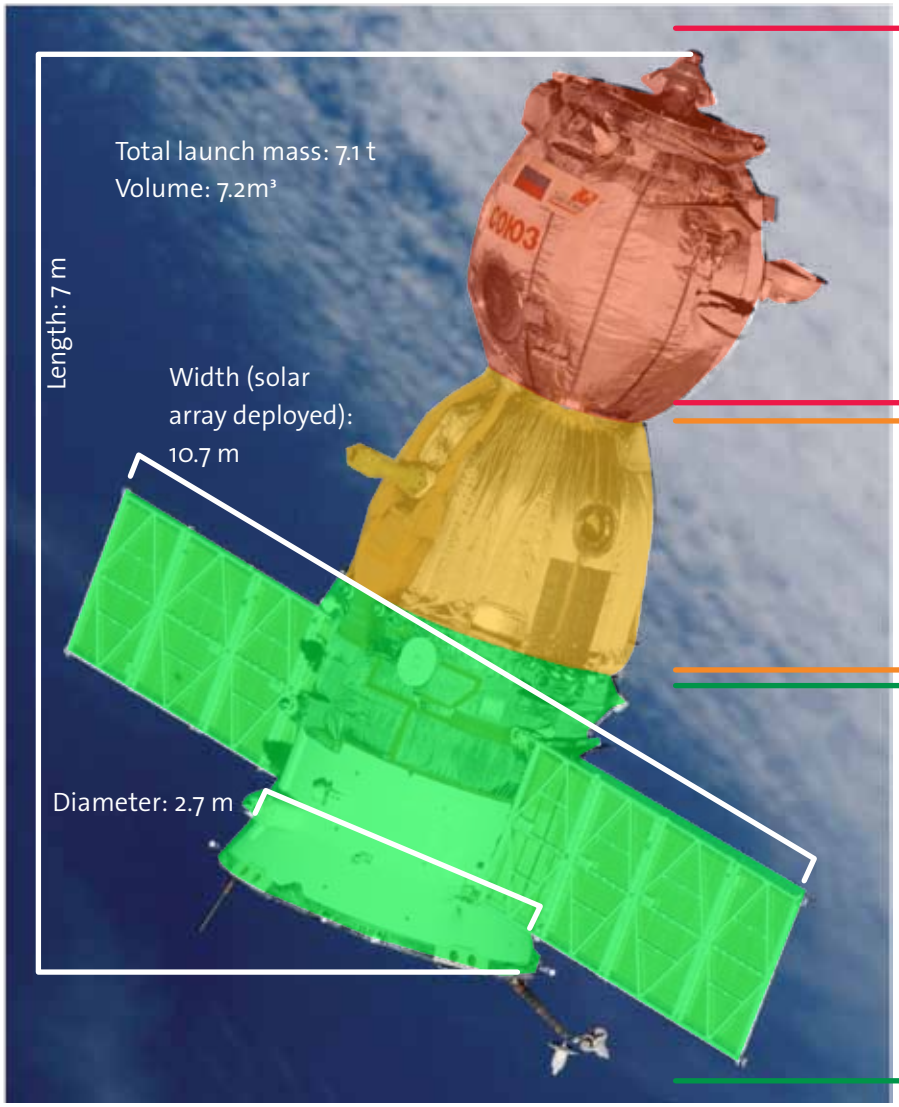
The Soyuz spacecraft shares the same name as its launcher – which means 'union'– and can manoeuvre, rendezvous and dock in orbit. With a height of 1.85m André will fit in the third of the TMA-M series, the latest upgrade to Russia's legendary manned vehicles.

Soyuz Insertion Timeline



Docking

Soyuz TMA-M3 spacecraft



Orbital Module

It is used only in space and acts as living quarters, with hygiene and sleeping facilities. Astronauts will spend two days inside it before docking.

Descent Module

This is the only module to return to Earth and is therefore designed to resist the aerodynamic stresses of reentry into the atmosphere.

Service module

It contains oxygen and propellant tanks, attitude control thrusters, electronics for communication and the primary guidance and navigation control systems. Astronauts have no access to it and all the functions are controlled remotely.

The crew training inside the Soyuz orbital module

The ‘digital Soyuz’

The modernised Soyuz will be used for qualification tests, including verification of the manual control modes. The new displays will make it easier for the crew to manoeuvre the spacecraft.

It is informally known as the ‘digital Soyuz’, referring to the advanced flight control computer that replaces the one that had been used on it for more than 30 years.

Obsolete pieces have been replaced with new-generation devices and the total mass reduced by 70 kg. Systems introduced in this round of modifications are meant to pave the way for the development of a new manned vehicle.

Each Soyuz spacecraft remains docked to the ISS for about six months to serve as a lifeboat. If necessary, Soyuz vehicles can change their docking location to clear the occupied docking port for another approaching supply craft.

→ EUROPEAN SCIENCE ABOARD

The International Space Station is a permanent research platform where the gravitational effects are minimal as a result of its free-falling condition. Conducting research in such a microgravity environment gives researchers a unique opportunity to study the true nature of biological, physiological and physical processes.

Europe's Columbus laboratory on the ISS

André will make use of the scientific facilities on the ISS, and especially in the Columbus laboratory. This European module provides scientists with a unique laboratory to conduct world-class research. Since 2008, Columbus has been Europe's 'entrance ticket' to the ISS and ESA's largest single contribution to the orbital outpost.

Nearly 30 experiments will be carried out during the PromISSe mission covering a wide range of disciplines. André will perform an extensive science, technology and education programme for the benefit of life on Earth, but also in preparation for future global human exploration missions.

Human Physiology

CARD

Just one week in space is enough to alter the dilation of blood vessels, increase cardiac output and lower blood pressure. There is a headward fluid shift, giving astronauts a distinctive 'puffy face' and 'chicken legs' appearance. CARD tries to understand how weightlessness affects the regulation of blood pressure. André's cardiac output will be measured repeatedly along with analysis of blood samples to give a better insight into clinical conditions such as congestive heart failure.

SOLO

Astronauts lose bone density while in space. European scientists are researching salt retention and related human physiology effects by analysing blood and urine samples for markers indicating the effects on bone metabolism. Samples will be taken during two special diets followed by André, one a low-salt diet, the second a normal salt level diet. This metabolically controlled study will help to shed light on bone physiology in space and on Earth. This could be especially useful for evaluating the optimal sodium intake for long missions without any negative effect on astronauts' health.

PASSAGES

Passing through a doorway seems quite an easy task on Earth. In orbit, the neurological processes we use to undertake this are no longer a reliable reference and could lead to erroneous estimates of physical dimensions. PASSAGES is designed to understand how perception strategies evolve in the absence of gravity effects. Rather than viewing a true physical opening, the participating subject will see images displayed on a computer screen and will make judgments (yes or no) as to whether he can pass through them.

THERMOLAB

When André enters microgravity conditions, some of his fluids, such as blood and lymph, will flow very quickly from the lower part to the upper part of his body. Changes in his heat balance are also linked to this fluid shift physiological effect. During André's daily exercise and rest time, the ThermoLab experiment uses a non-invasive measuring technique in order to record accurately his core body temperature adaptation under reduced gravity conditions.

André will follow a special diet under microgravity conditions to find an effective therapy against bone loss, in space and on Earth

EKE
The preservation of astronauts' aerobic capacity is a major goal of exercise countermeasures during space missions. A widely used measurement for endurance capacity is the maximal volume of oxygen used during exhaustive exercise. André will be a subject of EKE which assesses an alternative, more optimal method of measuring endurance capacity by reducing the time spent on assessment.

IMMUNO
The aim of this experiment is to determine changes in hormone production and immune response during and after a stay on the Space Station. Samples of saliva and blood will be taken from André's Russian crewmates to check for hormones associated with stress response and for carrying out white blood cell analysis. An increased understanding of the coupling between stress and the functioning of the immune system also has relevance for people on Earth.

André training with the Neurospat experiment

VESSEL IMAGING
This experiment uses ultrasound scans to evaluate changes in the properties of central and peripheral blood cell walls in weightlessness. By studying these changes in André's body during and after his five-month exposure to weightlessness, Vessel Imaging aims to optimise the countermeasures used during long-duration space missions. This experiment also provides unique opportunity to validate telemedicine concepts for routine medical checks.

SPACE HEADACHES
Headaches are not a pain exclusive to humans on Earth. Via regular questionnaires, this experiment studies the incidence of headaches during André's stay on orbit, as well as their prevalence. Headache characteristics in humans during space missions are analysed and classified according to the International Classification of Headache Disorders.

ENERGY
Negative energy balance observed during spaceflight may affect many physiological functions. Changes in André's energy balance and expenditure will be measured, which will help in deriving an equation for energy requirements in weightlessness. This will contribute to planning adequate, but not excessive cargo supplies for food.

NEUROSPAT
Reorganised perception in weightlessness is a unique demand that André's nervous system has to face. By recording the activity of the astronaut's brain during virtual reality stimulations, this experiment aims to detect the mechanisms involved in the altered behaviours in microgravity and to localise the crucial parts of the cerebral cortex involved. NEUROSPAT may provide a new tool for testing spatial cognition altered in normal ageing and pathological conditions.

Before and after: ground-based human studies

SARCOLAB
Exposure to microgravity is known to lead to loss of muscle mass, function and motor control. Sarcolab will be studying this by determining the contractile characteristics of muscles particularly affected, i.e. the plantar flexor muscles in the lower leg, during static and dynamic contractions. André will contribute to it by participating in muscle biopsy studies.


André checks his eyes to learn more about the effects of weightlessness on the human body

Before flight, André worked with the Muscle Atrophy Research and Exercise System

EDOS

Early Detection of Osteoporosis in Space is a study into the mechanisms underlying the reduction in bone mass which occurs in astronauts in weightlessness. This experiment will help in evaluating the structure of weight- and non-weight-bearing bones of cosmonauts using computed tomography together with an analysis of bone biochemical markers in blood samples.

SPIN

This experiment is a comparison between pre-flight and post-flight testing of cosmonauts using a centrifuge and a standardised tilt test. Their ability to maintain an upright posture without fainting will be correlated with measures of otolith-ocular function, i.e. the body's mechanism linking the inner ear with the eyes that deals with maintaining balance.

Biology

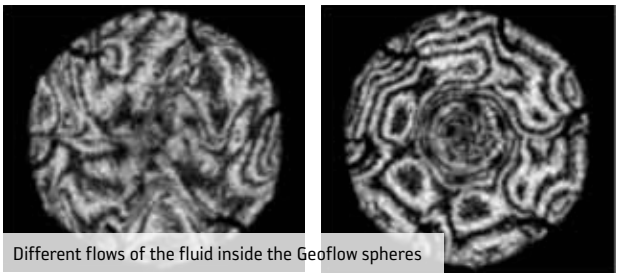
KUBIK-ROALD2

This experiment investigates gene expression of the proteins involved in the metabolic control of the neurotransmitter Anandamide. Scientists want to find out the role of this lipid in the regulation of immune processes and in the cell cycle under microgravity conditions.

Fluid Science

GEOFLOW-2

Geoflow-2 is investigating the flow of an incompressible viscous fluid held between two concentric spheres rotating about a common axis as a representation of a planet. This is of importance for astrophysical and geophysical problems such as global scale flow in the atmosphere, the oceans and in the liquid nucleus of planets. This study follows on from the first Geoflow experiment with new scientific objectives and a different experiment configuration.



Different flows of the fluid inside the Geoflow spheres

SODI/DSC

Working with the Microgravity Science Glovebox, André will support research to determine diffusion coefficients in different petroleum field samples and to refine petroleum reservoir models. This experiment could help lead to more efficient extraction of oil resources.

Materials Science

CETSOL-MICAST-SETA

These experiments examine different growth patterns and evolution of microstructures during crystallisation of metallic alloys in microgravity. The experimental results, together with numerical simulations, will be used to optimise industrial casting processes.

Training with the Microgravity Science Glovebox, together with ESA astronaut Frank De Winne

Radiation Research

DOSIS-3D

This experiment will carry out a three-dimensional monitoring of the radiation environment in all segments of the ISS using various active and passive radiation detectors to reveal the nature and distribution of the radiation field inside the Space Station.

ALTEA-SHIELD

Interactions between radiation in space and brain functions are among the major concerns when programming long stays in space. The light flashes observed in space are an example of such interactions, created when ionising particles pass through the eye. This next part of the experiment, called 'Shield', will test different shielding materials for their effectiveness against radiation.

TRITEL

One of the many risks of long-duration spaceflight is the exposure to cosmic radiation, which has great importance particularly during solar flares and higher solar activity. TriTel will undertake a 3D characterisation of the radiation environment in the Columbus module and will help in estimating the absorbed dose and equivalent dose burden on ISS crewmembers. It is still to be confirmed if this experiment will start during the PromISSe mission.

Solar Physics

SOLAR

The SOLAR payload facility, located externally on the Columbus laboratory, studies the Sun's electromagnetic radiation with unprecedented accuracy across most of its spectral range. The data acquired provides valuable contribution to long-term evaluation of the total solar irradiance. It also helps scientists in improving climate models and sharpening future weather forecasts. Such data can feed into the future design of satellites to prolong their life in orbit and to better tolerate the radiation effects.

SOLAR mounted outside the Columbus laboratory in 2008

ESA astronaut Paolo Nespoli filming the Altea Shield experiment with the ERB-2 camera on the ISS

Technology

VESSEL ID SYSTEM

Using Columbus as a test platform, this ESA satellite receiver brings worldwide sea traffic tracking within reach. Since its installation on ISS, this experimental ship detector has been pinpointing more than 300 000 vessels every day. The system helps to demonstrate the space-based capability for identifying ships on the open seas within the field of view of the International Space Station.

METERON

The International Space Station is currently the most realistic environment that resembles a future human exploration mission. Meteron is an architecture and series of technology experiments aiming to validate future human-robotic operations from space using the ISS. The experiments will carry out future mission simulations with real-time mission operations, including communications delays. The first experiment of this series will take place during PromISSe.

ERB-2

The Erasmus Recording Binocular 2 is a high-definition 3D video camera available on the ISS for recording and live streaming, thus providing a new way to run interactive videoconferences from the orbital outpost. ERB-2 takes advantage of high-definition optics and advanced electronics to provide a vastly improved 3D video effect for mapping the Station.

NODDING MECHANISM

The 'tracking device', also called NightPod, will be positioned in the Station's Cupola to support a Nikon 3DS camera in taking high-definition pictures of the Earth, especially at night. This very general purpose observation platform is based on an ingenious prototype developed by NASA astronaut Don Pettit in 2003. The stunning images obtained during previous missions show the borderless nature of our planet at night, as well as auroras and other weather phenomena. In a global outreach effort, the footage will be available for the public on the internet. The payload will also be used for education purposes in order to teach children and students about geography and demographic distribution on Earth.

Experiments with ISS partners

André Kuipers will also carry out experiments for the American, Japanese and Canadian space agencies (NASA, JAXA and CSA). More than 20 studies with the ISS partners will take place during PromISSe at around 30 different research facilities of the orbital module.

His bones, the microorganisms living in his skin and even his feelings will contribute not only to understand the effects and risks of human spaceflight, but will also help to benefit life on Earth. During André's stay in space, weightless crystals will grow, a robotic crewmate will continue testing its systems and the impact of microgravity on cucumber seeds will be tested.

Human Research

- Pro-K. Dietary intakes to predict and protect against changes in bone metabolism during and after spaceflight.
- Reaction self test. Psychomotor vigilance test.
- Integrated Cardiovascular. Cardiac atrophy and diastolic dysfunction during and after long duration spaceflight.
- Integrated Immune. Validation of procedures for monitoring crewmember immune function.
- Repository. Biological specimens provide a means for investigating the physiological responses to spaceflight.
- Kinematics-T2. Biomechanical analysis of treadmill exercise on the ISS.
- Biomedical analysis of human hair exposed to a long-term spaceflight (HAIR).
- Mycological evaluation of crew member exposure to ISS ambient air (MYCO).
- VO2 Max. Evaluation of maximal oxygen uptake and estimates before, during and after long duration missions.

Fluid Physics, Materials and Combustion Science

- Protein Crystal Growth (PCG). Growth of crystals by the counter-diffusion technique.
- Marangoni experiment (MEIS). Surface tension driven flow.

Technology Demonstrations

- Robonaut. An on-orbit robotics capability within the Space Station.
- Photosynth. Three-dimensional modelling of the ISS.
- Super sensitive HDTV system checkout and video downlink (SS-HDTV).

Radiation Dosimetry

- Altea Dosi. Measures of cosmic radiation in the US Destiny laboratory.
- Area Passive Dosimeter for Lifescience experiments in Space (Area PADLES). Survey of the radiation environment on board the Japanese Kibo laboratory.

Biology

- Dynamism of auxin efflux facilitators (CsPINs). Studying the gravity response of dry cucumber seeds.
- Microbe. The experiment tries to identify types of microbes in the Japanese Kibo laboratory by long-term sample collections.

Education and Earth Observation

- Crew Earth Observations (CEO). Photography sessions over designated areas of Earth.
- ISS knowledge acquired by middle schools (EarthKam). Remote imaging and terrestrial research for students.
- ISS Ham radio. Amateur radio on the Space Station.
- Education Payload Operations Demonstrations (EPO Demos). Educational videos recorded by astronauts on board the Space Station.
- The Space Voice of the Open Mind (Chuon). Investigating the effects of space environment on feelings, opinions and minds.

esa European Space Agency

→ TRAFFIC AT THE STATION

After helping to build the Station for more than 10 years, and flying more than 130 missions, the Space Shuttle retired in July 2011, marking the end of an era for the US space programme. From now on, the ISS is relying on unmanned expendable cargo vehicles provided by the international partners.

André and Oleg training for ATV's arrival

Together with the Russian Progress spacecraft, traditionally used as the resupply vehicle for the Station, Europe's third Automated Transfer Vehicle will dock during the PromISSe mission.

André should also witness the flight of the first demonstration flight of the Cygnus resupply vehicle from Orbital Sciences Corporation in 2012, which incorporates a European-built pressurised module, and the Dragon demonstration cargo vehicle from SpaceX, part of NASA's commercial resupply service programme.

Visiting vehicles timeline

January
Dragon 2 (SpaceX)

February
Cygnus 1 (Orbital Sciences)

March
ATV-3 (ESA)

April
Dragon 3 (SpaceX)

ATV *Jules Verne* following undocking from the International Space Station

ATV, the largest space freighter

The third Automated Transfer Vehicle, *Edoardo Amaldi*, is currently scheduled to be launched to the Space Station at the beginning of March 2012 from ESA's Spaceport in Kourou, French Guiana. With its own flight control avionics and propulsion systems, Europe's most complex spacecraft has a high level of autonomy allowing it to navigate on its own and control its own rendezvous.

André will be the prime operator, monitoring the ATV rendezvous and docking. André and his crewmate Oleg Kononenko will monitor the ATV as it approaches the Station. They are well trained to intervene in case any off-nominal situation prevents the ATV from docking.

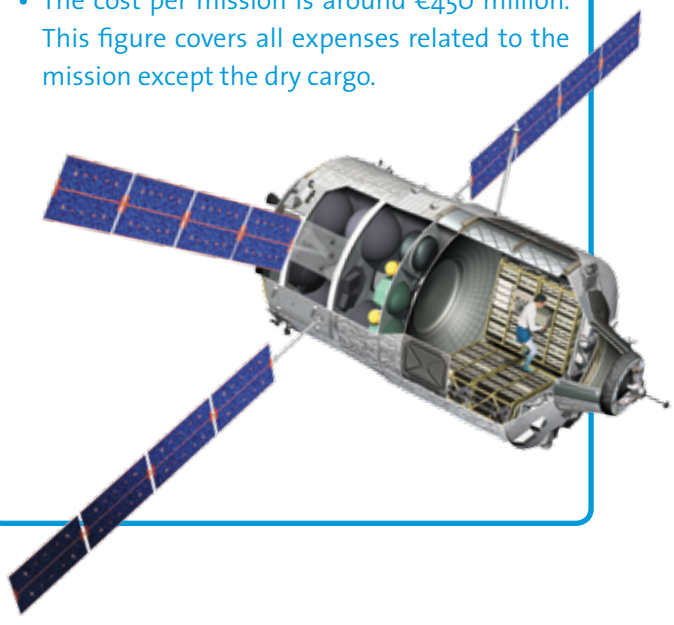
ATV-3 is a cargo carrier, storage facility, waste remover and as a 'tug' vehicle. Named after a leading Italian scientific figure of the last century, the European space ferry will deliver almost 7 tonnes of cargo, including around 3 tonnes of propellant. With it, Europe is contributing in kind towards its share of the operational costs of the International Space Station.

Edoardo Amaldi will not only provide the astronauts with food, water, gas and research equipment, but will also help in adjusting the Space Station's orbit and assist the docking operations of other ISS visiting vehicles. The spacecraft can perform regular orbital reboosts and occasional manoeuvres to avoid collisions with space debris.

After about five and a half months, ATV-3 will undock from the Space Station and burn up harmlessly in the atmosphere over an uninhabited area of the Pacific Ocean.

ATV facts

- It is the heaviest spacecraft ever launched by ESA and on an Ariane rocket.
- It can carry in total about three times the payload capacity of a Russian Progress-M and somewhat more than a Japanese HTV.
- It has a high level of autonomy, allowing it to navigate on its own. It can dock automatically with the Station with a precision of better than six centimetres.
- It has the largest reboost capability thanks to Europe's most complex propulsion system. The engines of the ATV-3 predecessor, *Johannes Kepler*, achieved the biggest boost for spaceflight since the Apollo missions to the Moon – the ISS orbit was raised by more than 40 km.
- It can provide water, different gases, refuelling propellant, dry cargo and ISS attitude control and reboost during a single mission.
- It is a multifunctional spaceship, combining the fully automatic capabilities of an unmanned vehicle with human spacecraft safety requirements.
- It has the largest flight software ever developed by ESA.
- About 2000 people from ESA and the European industry have been involved in the ATV project.
- The cost per mission is around €450 million. This figure covers all expenses related to the mission except the dry cargo.



→ SPACE FOR EDUCATION

Since the installation of the Columbus module on the ISS, ESA astronauts have carried out educational programmes with a twist. Thousands of school children can participate in André's experiments from the ground.

Spaceship Earth

During his stay in orbit, André will have a unique view on 'Spaceship Earth' from his own spaceship, the International Space Station. From the spectacular vantage point provided by Cupola, the ESA astronaut will have the opportunity to observe both the beauty and fragility of our planet.

His observations will support the ESA online lessons designed to help European children aged 10–14 strengthen their knowledge in science, technology, engineering and mathematics.

ESA and the Netherlands Space Office have worked together to make André's education programme a comprehensive and exciting one to follow for students and teachers. All educational material will be available online at the PromISSe website.

Themes

Life

- Spaceship ISS and Spaceship Earth
- Human Body
- Influence of humans on Earth and Earth on humans

Biodiversity

- Biodiversity
- Ecosystems
- Extreme environments

Climate

- Micro-climates
- Weather systems
- Large climate phenomena and space climate

Experiments

Students aged 10–14 years old will be able to perform their own identical experiments and discover how convection and foams differ under the influence of gravity compared to the Station's weightless environment.

EPO CONVECTION

This demonstration illustrates to students on a small scale how thermal gradients drive convective currents and thus, on the large scale of a planet, how temperature gradients influence density-driven convection and create atmospheric and oceanic currents.

The European astronaut invites you to try out science experiments

EPO FOAM-Stability

This experiment will demonstrate physical properties of wet foams and how gravity influences stability as well as how understanding foam formation and stability can help us make cutting-edge materials. André will show to students how a foam is created from pure water in microgravity, and observe its stability.

Mission X: Train Like an Astronaut

Astronauts need to stay fit on the ground and in space. ESA and other space agencies are using the example of space explorers to promote regular exercise and healthy nutrition among young people worldwide.

André is the European ambassador of Mission X: Train Like an Astronaut, an educational programme for primary school pupils aged 8–12 years led by NASA. Thousands of students are invited to perform physical exercises and classroom lessons, competing with teams from around the world to become as fit as astronauts.

André helping schoolchildren with space-related projects

Teams of children will practise scientific reasoning and teamwork while participating in hands-on activities during their school lessons. Modules like 'Do a Spacewalk' and 'Climb a Martian Mountain' are among the tasks, targeting strength, endurance, coordination, balance and spatial awareness. Mission X is helping the next generation of space explorers to boost their health and fitness.

This educational project will leave the launch pad in February 2012 and run for six weeks.

Participating countries

Austria, Belgium, Colombia, Czech Republic, Denmark, France, Germany, Italy, Japan, the Netherlands, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

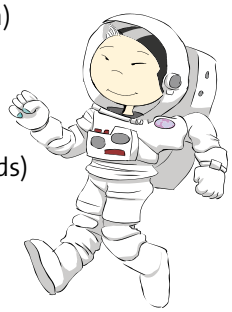
Training sessions to be as fit as an astronaut

Take your classroom into space

Using good scientific practice, students on the ground will compare their results with André's identical space experiments, by means of both recorded and live-link activities for educational events.

INFLIGHT CALLS

EPO Convection and Foam Stability
End of April
Nemo Science Center, Amsterdam (The Netherlands)
Speyer Techniek Museum, Speyer (Germany)
National Space Centre, Leicester (United Kingdom)
Parque de las Ciencias, Granada (Spain)



Mission X
Beginning of February
SpaceExpo, Noordwijk (The Netherlands)
Infini.to, Torino (Italia)
Ciencia Viva, Lisbon (Portugal)
Museum.BL, Basel (Switzerland)

→ SUPPORT FROM THE GROUND

A worldwide network of control centres is following the life and work on the Station. These centres will monitor every single thing during the PromISSe mission, ranging from the visiting spacecraft to experiments being performed in the Columbus module. In case of changes or any malfunctions, the control centres are on the front line to take the necessary measures.

Researchers from all over Europe can follow up their experiments in space from the several User Support and Operation Centres (USOCs) that ESA has in Europe or even directly from their workplaces. Their efforts are channelled through the Columbus Control Centre in Oberpfaffenhofen, near Munich in Germany.

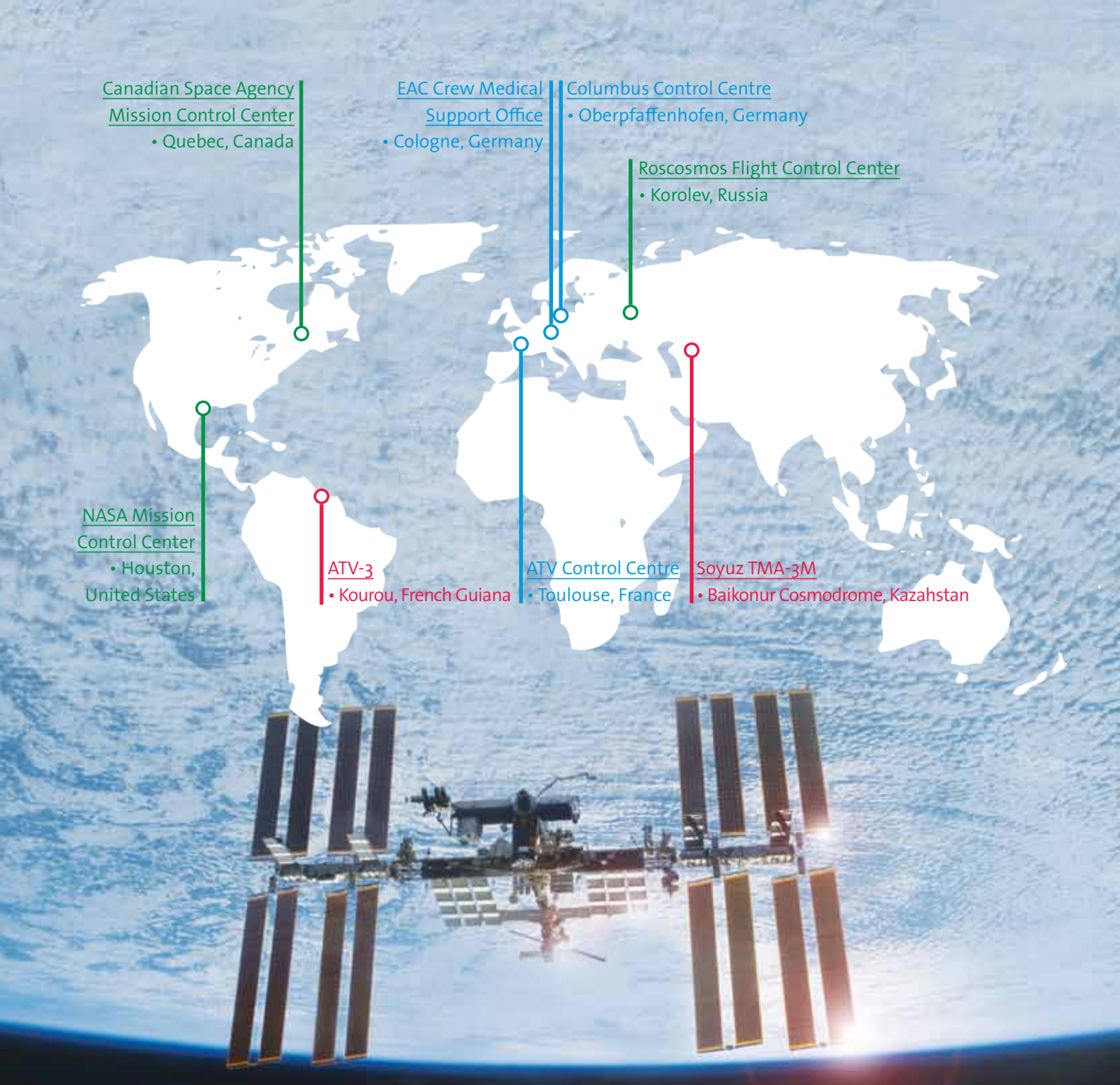
This centre's main functions are to command and control the Columbus laboratory systems, to coordinate operations and to operate the European ground communications network. There is also a weekly conference with the Space Station to check the status of the ongoing science experiments.

The expertise and teamwork of ground systems engineering and operations staff make the PromISSe mission possible

The User Support and Operation Centres are based in national centres distributed throughout Europe. These centres are responsible for the use and implementation of European payloads on board the Station.

The Automated Transfer Vehicle Control Centre (ATV-CC) will be the direct link to ATV-3 in orbit. Although docking with the ISS is fully automatic, ATV-CC is able to direct the approaching and separation of *Edoardo Amaldi* from the ISS.

Every week, the EAC Crew Medical Support Office will have a conference with André Kuipers to check his health in space. The team provides guidance and advice for all medical procedures, in-flight fitness and countermeasures.



LAUNCH SITES

Soyuz TMA-3M
• Baikonur Cosmodrome, Kazahstan
ATV-3
• Kourou, French Guiana

EUROPEAN CONTROL CENTRES

Columbus Control Centre
• Oberpfaffenhofen, Germany
ATV Control Centre
• Toulouse, France
EAC Crew Medical Support Office
• Cologne, Germany

ISS INTERNATIONAL CONTROL CENTRES

NASA Mission Control Center
• Houston, United States

Roscosmos Flight Control Center
• Korolev, Russia
Canadian Space Agency Mission Control Center
• Quebec, Canada

→ THE WAY BACK TO EARTH

After living and working on the ISS for nearly 150 days, spanning both Expeditions 30 and 31, André will return to the Soyuz capsule with his crewmates. The spacecraft will undock from the Station on 16 May 2012. The closure of the Soyuz hatch will signal the end of the PromISSe mission, and the astronauts will land back on Earth only a few hours later.

Reentry and landing on the steppes of Kazakhstan is a relatively quick procedure, taking no longer than three and a half hours. Shortly after undocking, the Soyuz spacecraft separates into its three parts. The orbital and service modules burn up on reentry in the denser layers of Earth's atmosphere.

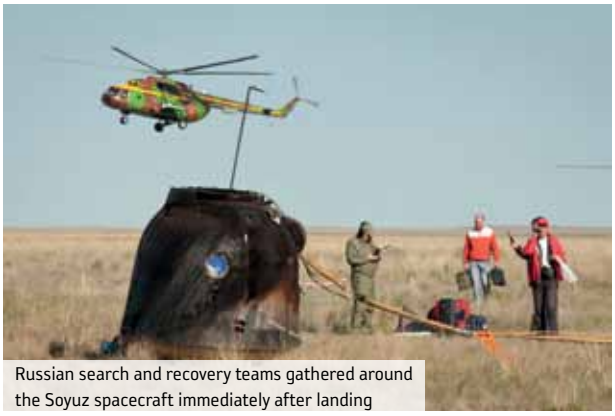
The descent module rotates and places the strongest parts of the heatshield towards the reentry direction, so that it can absorb most of the heat caused by friction. Reentry occurs at an altitude of approximately 120 kilometres, when the speed is reduced dramatically and the crew is pushed back into their seats by a force of 4–5 *g*. This is equivalent to four to five times their own body weight.

The parachutes and the Soyuz's shock-absorbing seats soften the landing, together with retro-rockets firing just before touchdown. The descent module usually touches down on Earth at a speed of less than 2 metres per second, or around 5km per hour.

After landing, the crew will deploy a communication antenna, so that the rescue teams can pinpoint their precise location. The Soyuz capsule is not reusable.

Once rescued from their landing site, André will be taken directly back to Houston from Baikonur, for rehabilitation and post-flight body data collection.

The Soyuz spacecraft lands in a remote area of Kazakhstan



Russian search and recovery teams gathered around the Soyuz spacecraft immediately after landing

André Kuipers safely back on Earth after completing the 11-day Delta mission in April 2004

→ UNDOCKING AND LANDING TIMELINE

1. **00:00 min.**
   Separation command
   Separation command to begin opening hooks and latches, which hold the Soyuz spacecraft on a docking port on the Space Station

2. **+00:03 min.**
   Separation from ISS
   Hooks opened. Soyuz begins physical separation from the docking compartment at 0.1 m/s

3. **+00:06 min.**
   Separation burn from ISS
   A 15-second separation burn when the Soyuz is about 20 m from the Station

4. **+02:29 min.**
   Deorbit burn
   When the Soyuz is at a distance of about 19 km from the ISS, the engines fire for almost five minutes

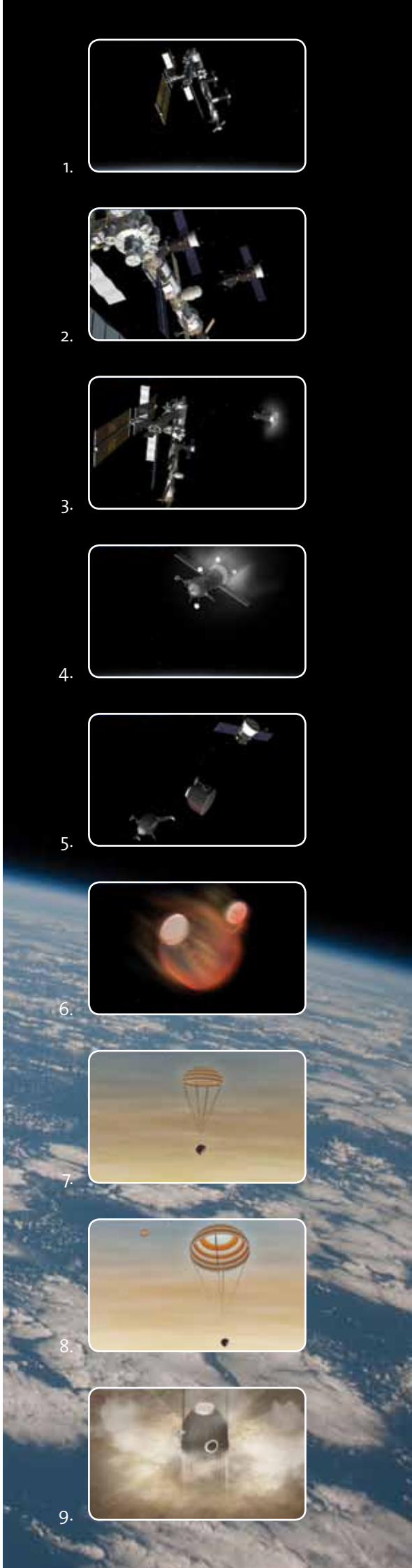
5. **+02:57 min.**
   Separation of modules
   The unoccupied Orbital Module separates from the Descent Module and burns up on reentry into the atmosphere

6. **+03:00 min.**
   Entry Interface
   The Soyuz reaches Entry Interface at 122 km altitude

7. **+03:08 min.**
   Opening parachutes
   Parachutes are commanded to deploy:
   - Two pilot parachutes.
   - Drogue chute. It slows the spacecraft's descent from a rate of 230 m/s to 80 m/s.
   - Main parachute. It slows the Soyuz to a descent rate of 7.2 meters per second. The Soyuz descends at an angle of 30 degrees to cool, then the main parachute shifts it to a straight vertical descent.

8. **+03:22 min.**
   Soft landing engine firing
   Six soft-landing engines fire to slow the vehicle's descent rate to 1.5 m/s just 1 m above the ground

9. **+03:23 min.**
   Touchdown
   Soyuz lands on Earth



→ SPACE NOTES

→ SPACE NOTES

→ USEFUL CONTACTS/LINKS

André Kuipers soon after arriving on the ISS for his Delta mission

For further information, please contact:

ESA/ESTEC
Communication Office
Tel: +31 71 565 3009
E-mail: Rosita.Suenson@esa.int

Directorate of Human Spaceflight and Operations
Promotion Office
Tel: +31 71 565 8687
E-mail: Karin.Suedkamp@esa.int

Credits

This document has been compiled, written and produced by the European Space Agency in Noordwijk, the Netherlands.

Photo credits: NASA, ESA

Useful links

ESA's PromISSe website:
www.esa.int/promisse

Twitter:
@astro_andre

ESA's YouTube channel:
www.youtube.com/ESA

ESA's Flickr account:
www.flickr.com/europeanspaceagency

Blog (in Dutch):
www.andrekuipers.nl