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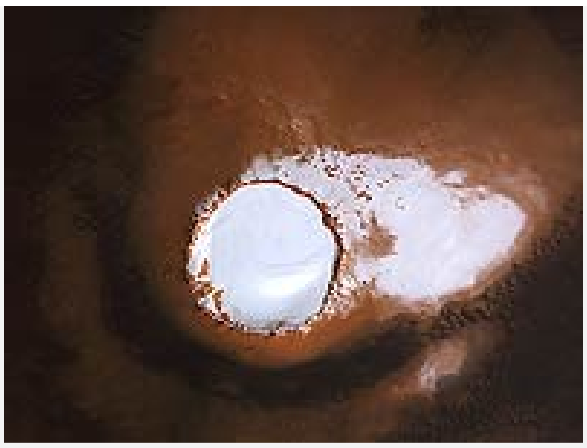
It just carries on working: The German HRSC onboard Mars Express now in its third year

10 January 2007

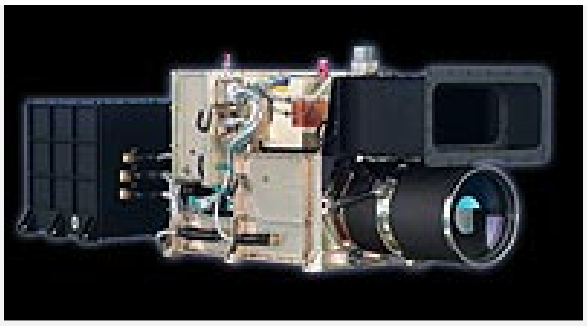


An ice-filled crater at Mars's north pole

Exactly three years ago today, the High Resolution Stereo Camera (HRSC) onboard the Mars Express probe captured its first image data of our neighbouring planet. After more than 3800 orbits of Mars, the camera has imaged an area larger than North and South America with a resolution of between ten and twenty metres per pixel, in colour and in 3D. The camera experiment onboard the European Space Agency's (ESA) first planetary probe is being managed by the German Aerospace Center (DLR). The *Freie Universität Berlin* (FUB) is playing the leading scientific role in the HRSC.

"The instrument is still working perfectly after nearly 4000 orbits of Mars", commented the delighted Ralf Jaumann, experiment manager from the DLR Institute for Planetary Research in Berlin-Aldershof, about the reliability of the HRSC, "and there's no reason why the HRSC shouldn't provide us with many more years of service". The scientific leader of the HRSC experiment, the Principal Investigator (PI), Gerhard Neukum, from the FUB, is also confident that the defined objectives can be achieved, at least by the end of this year. "We will have mapped over fifty percent of Mars in very high resolution, in colour and, most excitingly, in 3D format", explains the scientist.

"Having said that, together with the leaders of the other six experiments on Mars Express we are striving to obtain a second extension to this mission: We want to record as much of the surface as possible in the HRSC's maximum resolution of ten to twenty metres per pixel." ESA will come to a decision on a further extension of Mars Express at the end of February.



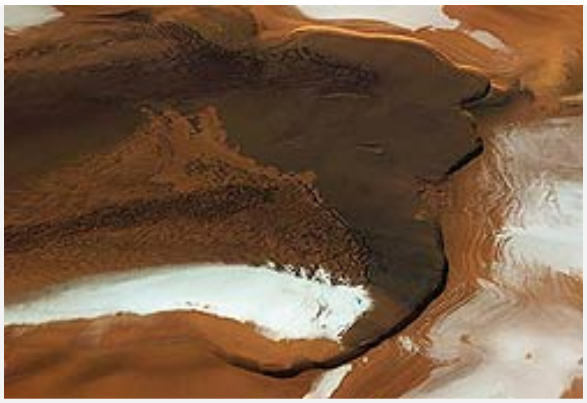
HRSC - the High Resolution Stereo Camera

The complex image data from DLR and FUB will be integrated onto a global 3D image map in one of the DLR-sponsored special projects from 2007. Over the next few years, this will give Mars scientists from all over the world access to what we call "digital terrain models": The HRSC will generate a topographical collection of data from the surface of Mars of a quality which has never been seen before. Pictures taken by the stereo camera in resolutions from ten to a hundred metres per pixel cover approximately two thirds of the surface of Mars. The objective of this camera experiment is to record images of half of the planet in a resolution of 10-20 metres per pixel in 3D and in colour by the provisional end of the Mars Express mission on 31 October 2007.

The camera, built and developed at DLR by a team led by the Principal Investigator in cooperation with German industry partners, scans strips of terrain on the surface of Mars using nine banks of light-sensitive sensors set at right-angles to the direction of flight. These strips, which are imaged at different angles of view and through four colour filters, are many hundreds of kilometres in length. As expected, the HRSC painlessly came through a phase for the second time at the end of 2006 when Mars disappeared behind the Sun and the camera remained switched off for several weeks for safety reasons. The HRSC project is currently the most comprehensive German experiment to be involved on a planetary mission.

The HRSC had already taken its first image strips of some 700 kilometres in length on 10 January 2004 during Mars Express' tenth orbit. This took place while the orbit was being fine-tuned by staff at the ESA mission control centre in Darmstadt. A few hours later, these digital image signals reached the HRSC Experiment Team in the DLR Institute for Planetary Research in Berlin, for the first time making it possible to identify details of the Mars landscape on the monitor amid enthusiastic response from the scientists and engineers involved.

"Even today, in routine operations, we are discovering ever more fantastic, but above all highly interesting, details from a scientific point of view," says a delighted Gerhard Neukum. In three years, the HRSC has recorded 45 million square kilometres in a resolution of between ten and twenty metres per pixel. That represents 31% coverage of the 145 million square kilometres of Mars's surface, which is approximately the same size as all of Earth's continents put together. About 80 million square kilometres were recorded at a resolution of more than 40 metres per pixel (54.4%): That represents roughly an area eight times the size of Europe. In total, 68% or almost 100 million square kilometres was covered. Experiment manager Ralf Jaumann added "With a length of 4000 kilometres, we have created the largest recorded image in the Solar System!"



Ice and dust layers

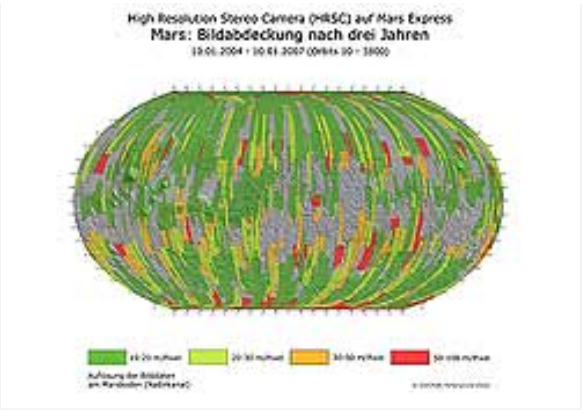
In this process, approximately 1.5 terabytes of compressed data from Mars Express were sent back to Earth. The HRSC Experiment Team in Berlin Adlershof decompresses and calibrates these packages of raw data and tests them for minor data errors. The Experiment Team then converts all data into

geometric image mapping projections. Then, so-called "digital terrain models" are generated by combining different HRSC channels, where the third dimension becomes visible and altitude measurements can be prepared in the image data. The different data products will be made available to all scientists through ESA and NASA data archives after about six months.

Mars Express took six months to cover the 55 million kilometres, which separate Earth from our neighbouring planet and arrived on 25 December 2003. Originally, the mission was planned to last only one Mars year, which is the equivalent of two Earth years. The huge scientific success of the mission prompted the ESA to prolong it, initially through 2006 and 2007.

As well as Mars Express there are also the two NASA probes Mars Odyssey (arrival at Mars on 24 October 2001) and Mars Reconnaissance Orbiter (arrival 10 March 2006) currently actively engaged in orbit around Mars. Only recently, NASA lost all contact with the Orbiter Mars Global Surveyor, a ten-year old, extremely successful "Mars veteran". Spirit and Opportunity, two NASA Rovers have been roaming slowly over the arid surface of Mars since January 2004, almost as long as Mars Express. None of these Mars missions are competing with each other and area instead mutually complementary within the framework of a worldwide Mars Exploration programme. In this context, the Hirsch's 3D image data is forming the basis of a topographical map covering the whole of Mars.

These HRSC images have provided the answers to numerous scientific questions: The 45 strong HRSC science team was able to identify traces left behind by glaciers, water courses and surface water million or even billions of years ago on today's arid surface, and clarify when and where water and ice formed the surface of Mars - mainly in the early part of the planet's four and a half billion year history.



Three years of Martian mapping with the HRSC

The topographical image maps will also be used to select future landing zones for unmanned Mars probes. Within the framework of its Aurora programme at the start of the new decade, ESA is planning intensive exploration of Earth's moon and in particular Mars in the ExoMars project which is being hailed as a "Flagship mission" to our neighbouring planet.

Amongst other things, ExoMars will be attempting to provide insights to still unanswered questions concerning the existence of past or even present life on Mars by using a Rover vehicle capable of covering wide areas of terrain. DLR will be collaborating with different scientific contributions and technical developments on ExoMars and the team from the Freie Universität Berlin will also be making their own scientific contribution.

The HRSC camera experiment on the European Space Agency Mars Express mission is led by Principal Investigator (PI), Professor Gerhard Neukum, (Freie Universität Berlin), who was also responsible for designing the high-resolution stereo camera. The science team comprises 45 co-investigators from 32 institutes and ten nations. The camera was developed at the German Aerospace Center (DLR) led by PI G. Neukum and built in cooperation with industrial partners (EADS Astrium, Lewicki Microelectronic GmbH and Jena-Optronik GmbH). It is operated from the DLR Institute of Planetary Research in Berlin-Adlershof in conjunction with ESA/ESOC. The systematic processing of the HRSC data takes place at DLR. The illustrations shown here were generated by the PI group at the Institute of Geological Science at the Freie Universität Berlin in conjunction with the DLR Institute of Planetary Research.

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