National Aeronautics and
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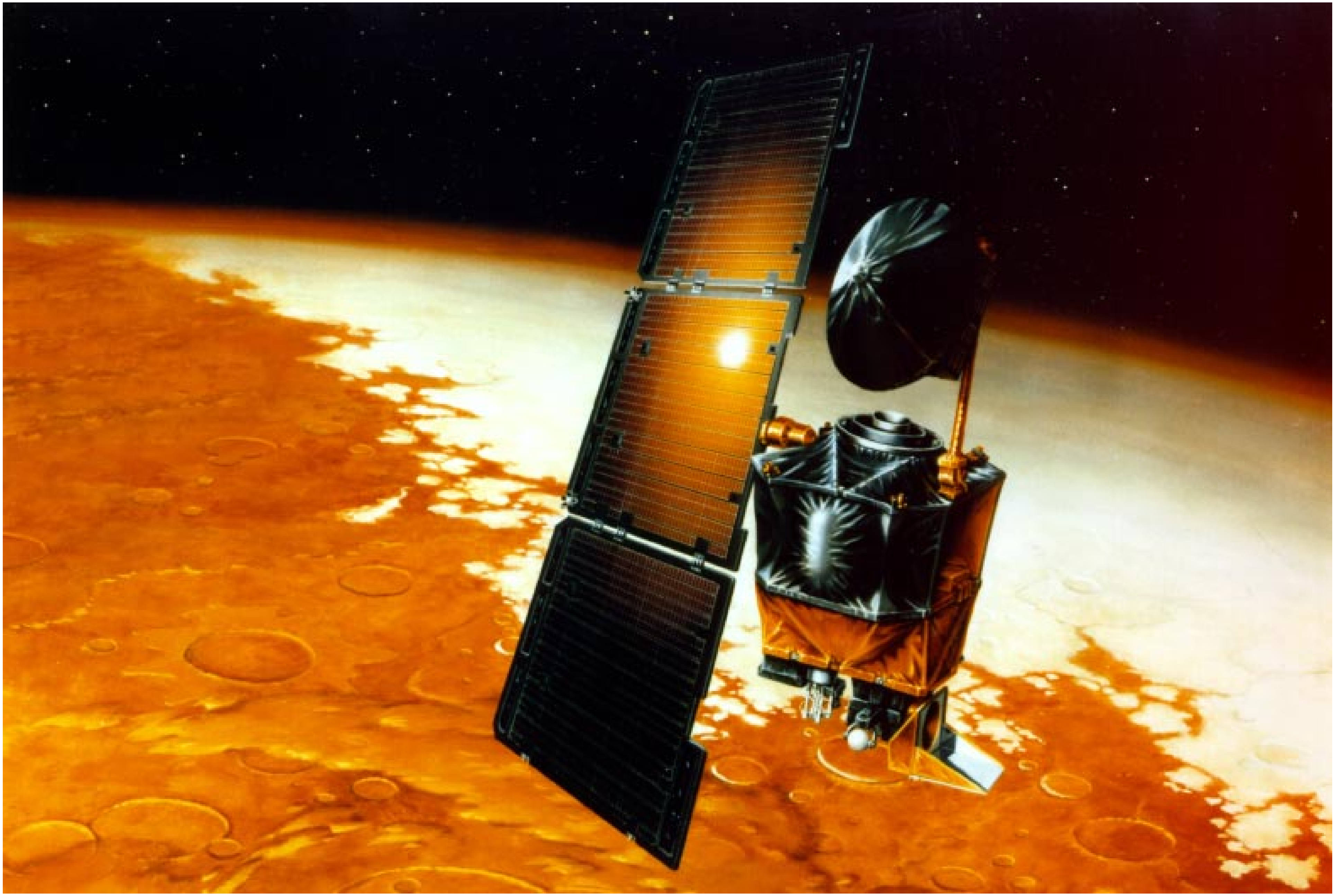
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Watching Martian Weather: Mars Climate Orbiter



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Watching Martian Weather: Mars Climate Orbiter

NASA's Mars Climate Orbiter is designed to observe Mars from orbit through one Martian year (687 Earth days) to study Mars' atmosphere and surface through four seasons. Seasons on Mars are similar to those on Earth — spring, summer, fall, and winter — but last nearly twice as long. In addition to collecting data, the Orbiter will act as a relay in data transmission to and from NASA's Mars Polar Lander, as well as the lander mission that will arrive on Mars in 2002.

Weather, Water, and Climate. What forces shape Mars' weather, now and in the past? Are they like those on Earth? Can the seasonal changes that we see today tell us about climate changes of the past — and what will occur in the future? What implications do these climate changes have for the development of life on Mars? Over the next decade, an international fleet of scientifically equipped robotic spacecraft will arrive at the Red Planet searching for answers to these and other questions.

Although water flowed freely on Mars' surface in the distant past, the Red Planet today has no oceans, lakes, rivers, or rain. Like Earth, however, Mars is a world with a dynamic atmosphere. Clouds of water ice and frozen carbon dioxide (dry ice) drift across the cold, parched surface. Weather systems move through the atmosphere much as they do on Earth. Dust storms can cover regions of the surface or the entire planet, a weather phenomenon that is unique to Mars. The surface of Mars is also being reshaped by the atmosphere, as winds erode the surface, reshape sand dunes, and carry dust around the planet.

Like Earth, Mars experiences dramatic changes in climate over short periods of time, such as seasons and years, and over long periods of time, from the birth of the planet to the present. Certain weather forces are always at work: heating and cooling, moving materials through the atmosphere, and exchanging mass and energy between the atmosphere and the surface. By studying the atmosphere of Mars over an entire year, we can learn how these forces work today and how they might work over much longer periods of time. Understanding the current climate also helps us understand how humans and robots would adapt to Mars.

Instruments and Measurements. Two instruments are aboard the Orbiter: the Pressure Modulator Infrared Radiometer (PMIRR) and the Mars Color Imager (MARCI). PMIRR will provide detailed information about the atmospheric temperature and changing distributions of dust, water vapor, and clouds. It will also determine how the heat balance near the poles changes over the course of a year, in order to understand the annual growth and recession of the seasonal polar caps, which are mainly CO_2 (dry) ice.

MARCI comprises two cameras that will observe the behavior of clouds and hazes in the Martian atmosphere and the emplacement and removal of dust and ice on the surface of the planet. Each day, its wide-angle camera will return data for a global mosaic of the atmosphere and surface, while its medium-resolution camera monitors the shape and color of the Martian surface. MARCI carries many more "color" filters than did its predecessors and will use these to study remotely the composition of the surface.

Together, PMIRR and MARCI will provide new insights into Martian weather and into seasonal changes in atmospheric circulation patterns, transport, and climate change — including the global redistribution of water and the initiation, spreading, and dissipation of planetary dust storms. These are the agents changing the current climate.

Aerobraking into Orbit. Mars Climate Orbiter was launched on December 11, 1998, aboard a Boeing Delta II/7425 rocket and will arrive at Mars on September 23, 1999. The spacecraft will fire its main rocket engine for 16 minutes to slow its speed and enter an elliptical (oval) orbit around Mars. Over the next two months, the orbit will be changed into a low, circular polar orbit — best for mapping the planet — by repeatedly dipping into the atmosphere and using atmospheric drag to slow the spacecraft. This "aerobraking" has been used by other missions, such as the Magellan spacecraft at Venus and the Mars Global Surveyor spacecraft, which is now observing Mars. This technique greatly reduces the amount of fuel that a spacecraft needs to carry, thus reducing the overall mass that must be launched from Earth, but care must be taken to watch for dust storms or "weather" in the upper atmosphere that could lead to overheating of the spacecraft.

The Mars Exploration Program is managed for NASA's Office of Space Science by the Jet Propulsion Laboratory (JPL), California Institute of Technology. JPL's industrial partner is Lockheed Martin Astronautics. Scientific instruments are operated by principal investigators at JPL and at Malin Space Science Systems.

Join us as we explore Mars! Log on to *http://mars.jpl.nasa.gov* to learn the latest news in these historic journeys of adventure.

Points to ponder for educators and students: What causes seasons? Why is a Martian year nearly twice as long as a year on Earth? Why do we need to understand the weather on Mars? Why is a circular orbit more useful in this case than an elliptical orbit? Why is a polar orbit more useful for this mission than an equatorial orbit?

Please take a moment to evaluate this product at ehb2.gsfc.nasa.gov/edcats/lithograph. *Your evaluation and suggestions are vital to the continual improvement of NASA's educational materials. Thank you.*

Artist's concept of Mars Climate Orbiter courtesy of Lockheed Martin Astronautics

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