Introduction to this special section: Remote sensing

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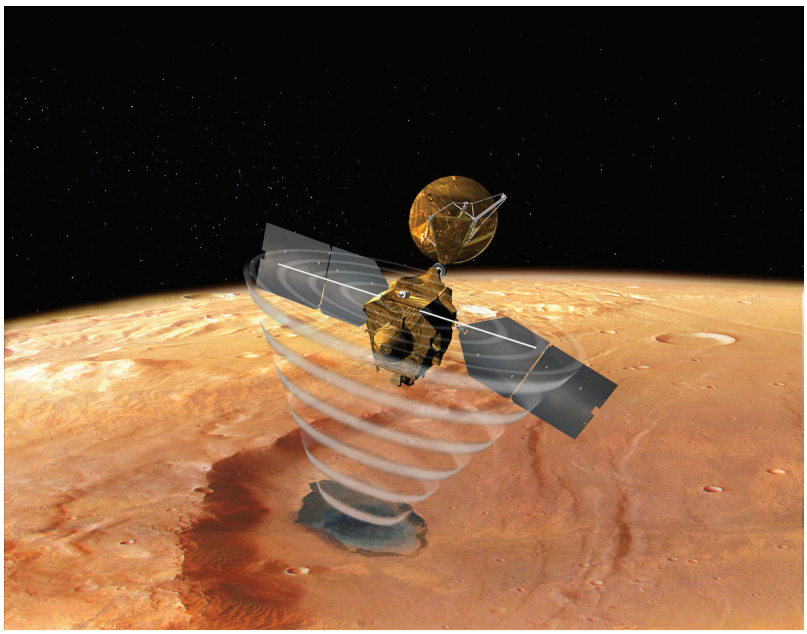
The broad field of remote sensing has long played a seminal role in the study of the earth, the environment, and our solar system. Through the advent and proliferation of air- and space-borne imaging systems, researchers have the capability to measure the physical and chemical characteristics of the surface geology of the earth and planetary bodies, monitor changes in vegetative biomass of entire continents, track global migration of water, measure surface heat flux, image the deformation of the earth's surface induced by human and natural processes, and many other applications. Importantly, many of these image products are made freely available to scientists, educators, and the general public by national space agencies, stimulating the flow of information and ideas while helping to grow the next generation of scientists.



Shown here is an artist's conception of a view looking down on the Mars Reconnaissance Orbiter. The spacecraft is depicted using its Shallow Radar (SHARAD) to "look" under the surface of Mars. In this issue (pages 43–57), Foss et al. discuss the work they've done using data collected by the SHARAD instrument. Image courtesy NASA/JPL.

Several characteristics of remote sensing imaging techniques make this field particularly appealing to researchers and operators interested in a diverse range of Earth processes. The first, of course, is the capability to remotely sense targeted regions without installing and maintaining expensive and spatially limited in situ equipment. This capability further supports investigations in regions that are remote or completely inaccessible. Second, remote sensing imagery commonly spans large spatial footprints (100s to 10,000s of square kilometers), allowing for the efficient analysis of broad spatial regions. The increasing spatial resolution of remote sensing instruments, which in some cases allots resolution finer than 0.5 meters per pixel, allows researchers to further interrogate the fine details of Earth surface processes, and repeated acquisitions help researchers to image the time-varying nature of Earth and environmental phenomenon. Lastly, common remote sensing technologies exploit a wide range of the electromagnetic spectrum, from ultraviolet to radio frequencies through both passive and active imaging sensors. The ways in which these frequencies interact with different Earth materials support the broad range of applications described previously. As these technologies continue to improve and become more entwined with in situ surface observations, the field of remote sensing will continue to provide new discoveries and further advance our knowledge of the characteristics and resources of our Earth and neighboring planets.

This special section of *The Leading Edge* focuses on remote sensing applications in industry. The diversity of contributions highlights the broad applicability of remote sensing in industry practices and demonstrates the capability of standard industry tools to address fundamental academic problems in Earth and planetary sciences. Krupnick and Kahn apply time-series analysis of the normalized differential vegetation index, generated from NASA's MODIS instrument, to track the impacts of hydrocarbon seeps on vegetation in and around production fields. Lord presents results of mapping hydrocarbon-related geology from multi- and hyperspectral imagery. Terry et al. explore the utility of airborne platforms for monitoring and mapping methane gas plumes. Samsonov employs satellite-based interferometric synthetic aperture radar imaging analysis to quantify the rates of induced surface deformation related to cyclic steam simulation in Alberta, Canada. Lastly, Foss et al. explore the three-dimensional internal structure of the Martian icecaps as imaged by an orbiting radiometer and ground-penetrating-radar analysis techniques.

Clearly, the papers in this special section demonstrate the utility of remote sensing to a broad spectrum of Earth and planetary applications. The use of remote sensing continues to gain momentum, and as new sensors and processing algorithms are developed, the products and resulting interpretations will only improve and gain a broader audience that is prepared to invoke this exciting technology. TLE

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