6 Special Issue on Global Environment Measurements

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The Communications Research Laboratory (CRL) has initiated a new round of research as an independent administrative institution under the Ministry of Public Management, Home Affairs, Posts and Telecommunications, as of April 1, 2001. The new CRL consists of four research divisions: (i) Information and Network Systems Division, (ii) Wireless Communications Division, (iii) Applied Research and Standards Division, and (iv) Basic and Advanced Research Divisions. The Global Environment Division, which was in charge of research and development relating to global environmental measurement technologies using radio waves and light when the CRL was operated under the Ministry of Public Management, Home Affairs, Posts and Telecommunications (or former Ministry of Posts and Telecommunications), has been incorporated into the Applied Research and Standards Division; it was joined with former Space Science Division, and Standards and Measurements Division. This new Applied Research and Standards Division performs research and development to apply acquired technology and knowledge in the info-communications field, with the aim of providing essential infrastructural support for info-communications.

The Applied Research and Standards Division focuses on research subjects with high relevance to the public—such as remote-sensing for global environmental monitoring and disaster monitoring, space weather forecast for the monitoring of solar activity and predicting its influence on the earth, and generation, measurement, and dissemination of standard time and frequency for their utilization in our daily life as a social infrastructure. Through this research, the Applied Research and Standards division contributes to the evolution of society and to the safety and well-being of the global community. The details of the goal of research into remote-sensing technology to be developed by the Applied Research and Standards Division in the new CRL is described by Dr. Hiroshi Kumagai at the beginning of this special issue on global environmental measurement.

In 1979, when the CRL was known as the Radio Research Laboratory (RRL) under the Ministry of Posts and Telecommunications, a division was established to conduct research and development on remote-sensing technology using radio waves. In the field of radio-wave propagation—one of the CRL (RRL)'s central areas of research—there was a strong need for investigation into the interactions between radio waves and the media in which they propagated. That investigation has evolved into the current research and development dealing with remote-sensing technology. In the period during which the shortwave played a central role in international communications, the state of the ionosphere, which determines the propagation conditions of shortwaves, was intensively investigated and monitored. In turn, when microwaves played a dominant role in major domestic communication networks, the technologies for measuring the troposphere, which affects the propagation of microwaves, were also subject to significant development.

Since wireless communications necessarily depends on natural conditions, research in this field has tended to focus on natural phenomena. This trend lies at the heart of the CRL's research, which seeks a useful balance between pure science and applied technology. Our research and development into global environmental measurements described in this special issue stems from this spirit of research, as we more directly measure wave-propagation media—the environment, in other words—using electromagnetic techniques. The technology for the observation of precipitation, in particular, follows in the footsteps of research into microwave attenuation due to precipitation, which began in the early years of satellite communications. In addition, the CRL has a long history of laser and lidar research, adding the novel light-based measurement techniques to our previous achievements.

CRL began its research into remote sensing at a time of worldwide explosion of satellite-based global measurement, with a number of related remote-sensing projects proposed at the time. Initially, such research projects were driven by a new epoch-making tool—the satellite, which enables us to watch the earth, our planet, from outside as a visitor from space, and acquire a new perspective on the earth; these endeavors were compared to the exploration of new continents in the Grand Navigation Era of the 16th century. Later, as people became aware that human activity has affected the environment on a global scale, and as so-called global environmental issues came to the forefront of public consciousness, the demand for practical global environmental measurement increased. As a result, measurement techniques and related data analysis based on remote-sensing technology have progressed in areas ranging from the atmosphere to the land and the ocean, and have been applied to observations of various types of ground cover including snow, ice, and vegetation. At the same time, under the aegis of the Earth Observation System (EOS), a number of modern sensors have been proposed and developed, with a number of countries and organizations, such as NASA and NOAA in the United States, several European countries and the European Space Agency (ESA), and Japan, working together on joint remote-sensing projects. In the period from the end of the 1980s to the 1990s, however, much of the excitement had faded due to economic stagnation and to space-shuttle accidents and setbacks. On the other hand, remote-sensing research continued to mature due to the sustained honest and sober efforts of researchers. Now remote-sensing has become an essential measurement technique in the science and technology related to natural phenomena, and currently provides a wealth of important data to the areas. Furthermore, remote-sensing has contributed to various areas of the researches through the introduction of innovative methods and concepts, both in terms of research and analysis. In addition, remote-sensing data has come to be very useful in a wide range of societal applications, from development to disaster-prevention.

In line with progress in remote-sensing technology, researchers and the public as a whole have changed their views regarding remote sensing. In its early years, this was viewed as a technology with extravagant possibilities. Now that the field has matured, it has become clear that possibilities alone will not meet the needs of the public. Instead, users demand that remote-sensing technology meet specific requirements in terms of data quality and timing in practical applications. This is an inevitable demand from the public in light of the growth in the field and the expansion of its applications-increased and closer relationship of the research and development in the field with social requirements. In short, people have come to the view that national research and development with its limited budget, supported by citizens' taxes, must yield not only academic results but must also make a direct and highly efficient contribution to society.

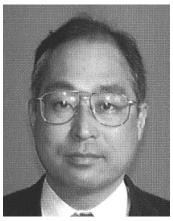
In light of the foregoing social demands, CRL has moved ahead with research and development into remote-sensing technology. Following its transformation into an independent administrative institution, CRL remains keenly aware of the necessity to set medium-term research objectives and to provide more clearly transparency and accountability for the public in terms of medium-term research plans. Specifically, we are required to identify concrete contributions—to illustrate the extent to which the sensors to be developed and the data to be provided will contribute to society, for example, or more specifically, to show how useful these sensors and data will be in global environmental protection, weather forecasting, disaster-prevention, and disaster monitoring.

The research themes introduced in this special issue are those that embody the above spirit, history, and expertise of the CRL. With respect to cutting-edge measurement technologies, CRL has conducted investigations into sensors and measurement techniques for use in space while at the same time developing ground- and aircraft-based measurement techniques for practical use. In this manner, CRL has proceeded with its original advanced research while pursuing research into practical applications. New satellite-borne sensor technologies are currently under development, following the success of the world's first Precipitation Radar of the Tropical Rainfall Measuring Mission (TRMM/PR) and subsequent satellite projects. Development of air- and balloon-borne systems and field measurements using such systems occupies a large portion of our activities; this is consistent with our tradition of gathering data from sensors deployed in flight objects, such as airplanes, a tradition that pre-dates our research into satellite-borne sensors. In the area of ground-based measurement technologies, innovative sensors are under development, with a particular emphasis in recent years on the use of multiple sensor combinations. Last but not least, another important area of research lies in the development of technology to enhance the availability of data using high-speed networks.

Thus this special issue presents a comprehensive summary of the latest results of CRL's remote-sensing research, following the "Development and experiment of airborne microwave rain scatterometer/radiometer system" in the Journal of the Radio Research Laboratory, published in June 1986 (Vol.32, No.163) and "Radio-wave and optical remote sensing" in the Journal of the Communications Research Laboratory, published in September 1989 (Vol.35, No.176).

Today, global warming has become an increasingly serious problem; we see the results of the global warming effect in a variety of areas. There is no sign of a reduction in the ozone hole although we have implemented corrective measures. Instead, even the Arctic Circle now presents a phenomenon similar to the ozone hole, which is currently under investigation in connection with global warming and recent climate anomalies. In this context, there can be no reduction in the emphasis placed on efforts to develop new global environment measurement technologies. Meanwhile, as discussed above, we are expected to provide concrete results in our research and development. For example, we are requested to present a scenario detailing the ways in which we will contribute to the precise prediction of global warming using measurement technology, and to provide the specific corresponding results. To achieve this goal, we must not only develop new sensors, but also enhance data availability for closer cooperation among those who use such data. The progress and results of research activities should also be properly evaluated for greater effectiveness in research management.

Against this backdrop, the CRL has established research groups in each of its divisions, as those involved in remote sensing move aggressively forward according to their respective projects. While such a project-driven research system is effective in providing prompt and specific results, it is not well-suited for the promotion of creative research based on individual originality. In order to produce pioneering ideas and novel measurement technologies that nevertheless meet user needs, bold ideas and individual originality are essential. The CRL now leads the world in remote-sensing technology, but to encourage further development in this area, we must form a balance between project research and original basic research, enabling us to both respond to social needs and to develop new concepts. CRL has yet to attain such an ideal research platform, and will be exposed to increasing social demands for more efficient research progress and management. Bearing all of the above in mind, we will continue to collaborate with domestic and foreign research institutes and to forge closer relationships with data users, as the field of remote sensing—as well as the CRL's itself—continues to evolve.



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Microwave Remote Sensing