Measurement of Ozone, UVB Radiation Is a Concern Over Latin America

PAGES 415, 419

A clear recognition of the unique role that Latin America plays in the global environment was one of several major themes to emerge at a recent workshop on distributions of ozone and UVB radiation over Latin America. The region covers a very broad latitude range and has a major influence on the atmospheric circulation of the southern hemisphere. The Andes Mountains, which cover a latitudinal range of more than 60° and are from 2 to 7 km in altitude, are unique not only because they force gravity waves, but also because of the opportunity they provide for satellite instruments to differentiate between columns of air over high mountains and nearby sea level. Appreciable emissions of trace gases and particles from both natural and human activity in Latin America have important effects on both regional and global scales.

The significant need for more ground- and balloon-based measurements in South America was also discussed at the workshop, particularly the need for vertical profiles of ozone, especially in the Andean region. Given the differences in meteorology and chemical background over the length of the Andes, more than one profiling station is needed. Participants also expressed a strong desire to have at least one major research station where a variety of column and profiling measurements could be located. Such a station would ideally be affiliated with the Network for Detection of Stratospheric Change (NDSC), the major international observing program that has a number of primary and complementary stations around the world but none at present in Latin America. It is not clear from where resources for such instrumentation would come. Few were optimistic that national or regional governments could provide the needed infrastructure and instruments, and it is not clear that any third parties, such as the Global Environmental Facility (GEF), are prepared to support additional instrumentation for atmospheric science and UV research. Discussions between atmospheric scientists, national scientific and environmental agencies, and international funding organizations on this issue are clearly needed.

Participants expressed hope that in some cases agencies in more developed countries could provide assistance on a "twinning" basis. Examples of current twinning arrangements include the support for ozonesondes in Kenya and Suriname provided by scientists from Switzerland and the Netherlands, respectively, and the planned augmentation of ozonesondes in Reunion Island, Natal, Brazil, and Wakutosek, Indonesia, by NASA. Such arrangements should involve local scientists not only in making the measurements but also in the analysis and interpretation of the results.

Many at the workshop agreed that measurement programs in South America, like those elsewhere, can only be successful if there is a strong commitment to continued support for instrument operation, maintenance, and calibration, as well as for personnel. Support also is needed to assure that data are validated and that there is close interaction with the World Meteorological Organization (WMO)/Global Atmosphere Watch (GAW) Quality Assurance Science Activity Centre for the Americas. Data should also be prepared in a standard format and deposited with the appropriate international archives, especially the World Ozone/Ultraviolet Radiation Data Center in Toronto, Canada.

A final major theme was the belief that scientists in the United States and Latin America should consider additional educational efforts to facilitate improved productivity by Latin American researchers. This potentially could include the organization of training programs on the use of satellite data for atmospheric chemistry and related meteorological parameters.

The workshop, "Understanding Ozone and UVB Radiation: Past Accomplishments and Future Opportunities," was organized under the auspices of the InterAmerican Institute for Global Change Research (IAI), the Secretariat of Science and Technology of Argentina, and NASA. It was designed to bring together scientists from across the Americas to discuss the state of knowledge of measurements of stratospheric and tropospheric ozone and the surface flux of ultraviolet radiation over Latin America, to understand the contributions of both ground- and space-based measurements to the study of ozone and UV radiation there, and to better coordinate existing activities. It was hosted by the newspaper *La Nacion* and more than 100 scientists participated from Argentina, Brazil, Chile, Costa Rica, Cuba, Peru, and Uruguay, as well as the United States, Canada, France, and Switzerland.

Much of the motivation for the meeting came from the recognition that although there has historically been little groundbased information on ozone and UV radiation over South America, new measurement programs have begun to increase data availability. At the same time, the availability of new satellite data products is increasing the need for correlative and complementary measurements, especially in the tropics and southern mid-latitudes. The Southern Cone Ozone Observing Project (SCO_3P) was established by the WMO through funding provided by the GEF program of the World Bank and is operated jointly by the United Nations Development Organization, the United Nations Environment Programme, and the World Bank. SCO_3P consists of stations measuring total ozone, surface ozone, and UVB radiation in Argentina, Brazil, Chile, Paraguay, and Uruguay. Latitudes from 13° to 55° S are included in this network.

Related WMO activity supports two major observing stations that were recently established as part of its GAW program—one in Arembepe, Brazil, in 1997, and the other at Ushuaia, Argentina, in 1994, the latter operated by the Argentine National Weather Service and the government of the province of Tierra del Fuego. Additional observing networks of note include one of six Brewer spectrophotometers (for total ozone and UVB measurements) set up by Brazil's Instituto Nacional de Pesquisas Espaciais (INPE). Four of these are in Brazil (at Natal, Cuiaba, Cachoeira Paulista, and Santa Maria), while the other two are a high latitude station in Punta Arenas, Chile, which is within range of the Antarctic ozone hole when it stretches beyond the pole, and another station is near La Paz, Bolivia, located in the Andes mountains. A regular series of ozonesonde measurements has been made from Natal, Brazil, since 1978, and the Dobson stations in Natal and Buenos Aires have provided a long record of total ozone measurements. Another Brewer instrument operates in Ushuaia, Argentina, in a co-operative project between Argentina and Italy. Furthermore, the Argentine Dobson network operates a recently installed instrument in Comodoro Rivadavia. Focused short-duration aircraft-based field campaigns, some of which involved surface measurement components, have been carried out in Latin America. Periodic balloon flights of instruments to obtain tropical stratospheric profiles also have been made in Brazil.

Several UVB measuring programs also have been established in Latin America, including a national UV network in Argentina with broadband spectrometers located in Jujuy, Buenos Aires, Pt. Madryn/Playa Union (the instrument location changed after implementation), and Ushuaia. UV radiation measurements also are being carried out in Rosario, some 300 km north of Buenos Aires. Instruments in Chile are located in Punta Arenas, Santiago, and Valdivia. Several UVB instruments have been set up in Colombia as well. There is also a UVB instrument in Ushuaia, Argentina, that forms part of the polar network established by the U.S. National Science Foundation (NSF). This instrument is operated jointly by the NSF and Consejo Nacional de Investigaciones Cientificas y Tecnicas, Argentina. A project to coordinate some of the UV instruments in Argentina and Chile has been supported through the IAI, and calibration and data exchange are key issues of the IAI activity.

Several other measurement locations currently are operating or under development within Latin America. These include microwave observations in Mendoza, Argentina, made with German support, and lidar instrumentation developed with support from France. A tropospheric/stratospheric aerosol lidar is now operational in Buenos Aires, Argentina, while a stratospheric ozone lidar is under construction. A major radar observatory, primarily dedicated to ionospheric research, is located in Peru and has provided information on temperature and wind profiles in the middle atmosphere. A Dobson station that had operated in Huancayo, Peru, for many years is currently not operating and may be moved elsewhere in Peru. Surface-based ozone measurements are also made as part of air pollution monitoring networks; a particularly detailed network has been established in the Sao Paulo, Brazil, metropolitan area.

Recent advances in space-based measurements have helped spur interest in obtaining information over Latin America. These include 1) development of tropical tropospheric ozone products from the Total Ozone Mapping Spectrometer (TOMS) series of satellite instruments (either by itself or in conjunction with other data sources, such as the Stratospheric Aerosol and Gas Experiment instruments); 2) use of TOMS to provide information on tropospheric aerosol distributions especially associated with UV-absorbing particles such as those from mineral desert dust, biomass burning smoke, and volcanic ash; 3) use of TOMS to determine surface UV fluxes based on TOMS ozone measurements and long wavelength reflectivity channel information (360 and/or 380 nm); and 4) availability of vertical profiles of a large number of trace constituents and aerosol profiles over Latin America and nearby oceanic regions from the Upper Atmosphere Research Satellite and the Stratospheric Aerosol and Gas Experiment instrument.

Data especially needed include vertical profiles of ozone over the entire Andes region from the subtropics south to Patagonia. Also lacking is information on the altitude distribution and optical properties of aerosols. These data are important for TOMS to provide quantitative information on aerosols. Such observations would significantly enhance the database for groundbased measurements of trace constituent profiles in the southern hemisphere, which are at present almost exclusively limited to the Lauder, New Zealand, station that forms part of NDSC. Also very helpful would be access to high-resolution radiosonde data that could be used for studies of atmospheric gravity waves. Such data are currently being archived by meteorological agencies in several countries (including the United States, Japan, and Australia) for scientists to use as part of gravity wave research carried out under the umbrella of the Stratospheric Processes and Their Role in Climate (SPARC) subgroup of the World Climate Research Programme. The availability of such data for South America is of particular interest because of the unique role the Andes may play in causing orographically generated gravity waves to form and propagate into the stratosphere.

Workshop participants were optimistic that the momentum generated by the meeting could be continued to address the important science and societal issues related to ozone depletion. A follow-up meeting will be hosted by INPE in 2000. Results from the Latin American science community on ozone and UV radiation are expected to be an important part of the Second World Congress of SPARC, scheduled to be held in Mar del Plata, Argentina, in November 2000.—*Jack A. Kaye, NASA Office of Earth Science, Washington, D.C., USA; Pablo Canziani, Department of Atmospheric Science, University of Buenos Aires, Argentina; Volker W. J. H. Kirchhoff, National Institute of SpaceResearch, Sao Paulo, Brazil; Michael Proffitt, NOAA Aeronomy Laboratory, Boulder, Colo., USA; and Bradford Wilcox, InterAmerican Institute for Global Change Research, Sao Paulo, Brazil*

The workshop, "Understanding Ozone and UVB Radiation," was held in Buenos Aires, Argentina, March 9–11, 1998.

BOOK REVIEW

Images in Weather Forecasting: A Practical Guide for Interpreting Satellite and Radar Imagery

PAGE 419

M. J. Bader, G. S. Forbes, J. R. Grant, R. B. E. Lilley, and A. J. Waters, Cambridge University Press, Great Britain, 499 pp., ISBN 0-521-62915-2, 1997, $59.95 (softcover).

Recent advances in meteorological instrumentation coupled with the ongoing data and infrastructure explosion promise significant improvements in the accuracy of weather forecasts. These advancements, however, increase the knowledge burden on the forecaster. Even relatively simple atmospheric upper air and surface sensors require forecasters to have some basic understanding of the instrumentation if they are to properly interpret the data they provide.

With whole careers dedicated to designing and interpreting data from meteorological satellites and radars, forecasters must be proficient users of these data. The new Doppler radars were considered so vital to National Weather Service operations that a massive, organized training program was held for operational forecasters, and applied research was funded to develop quantitative applications. Though satellite data have long been considered vital, training for satellite meteorology and image interpretation has largely been neglected. The education of contemporary meteorologists must cover both technical knowledge of individual data sets as well as the application of those data sets to the science of meteorology. Ideally, courses would utilize any and all available data to illustrate concepts being discussed. Few, if any, textbooks attempt to meet this daunting challenge.

The authors of *Images in Weather Forecasting: A Practical Guide for Interpreting Satellite and Radar Imagery* explain that similar sentiments caused them to undertake this effort before they realized the extent of the challenge. They were particularly concerned with the failure of operational forecasters to exploit satellite data in their daily routines. Given the ability of satellites to provide information on a wide range of scales of atmospheric motion and to provide virtually the only source of information over oceans and other data-sparse regions, they naturally emphasize satellites slightly over radar. This book covers proven image interpretation techniques for visible and infrared satellite data, mosaic radar reflectivity data, and radar reflectivity and velocity data. A notable omission from the book's content is that of microwave-wavelength satellite instrumentation and image interpretation.

What sets this book apart from recently published texts on satellite meteorology is its emphasis on how to conceptually integrate satellite and radar data with conventional surface and upper-air data to analyze evolving weather events. Both well-known and clever new diagrams nicely illustrate the three-dimensional aspects of widely accepted conceptual models of synoptic and mesoscale meteorology, which are evident in image examples. Portions of weather maps are often shown or superimposed on imagery. For example, the chapter on fronts and waves covers the complexities of fronts and frontogenesis by including topics such as split cold fronts, instant (pseudo) occlusions, and the impacts of synoptic scale waves, in addition to classic warm and cold fronts. These concepts are illustrated in a wide variety of ways, such as through variations on conveyor-belt theory diagrams, vertical cross-sections of air motion, surface weather maps, vertical temperature and moisture structure, and a wide