The Cooperative Institute for Research in Environmental Sciences (CIRES)

Annual Report on NOAA Cooperative Agreement NA67RJ0153

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Susan K. Avery, Director
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Overview

As the largest of eleven NOAA Cooperative or Joint Institutes, CIRES formalizes links between ten NOAA laboratories (most within the Boulder community) and eight departments plus three interdisciplinary academic programs at the Boulder campus of the University of Colorado. CIRES is also the largest of seven institutes within the University of Colorado system, employing over five hundred employees distributed between Fellows, research scientists, associate scientists, graduate students, undergraduate students, and administrative staff.

True to its name, CIRES scientists engage in cooperative research activities in a wide range of environmental sciences, with major foci in atmospheric and climate dynamics, cryospheric and polar processes, environmental chemistry and biology, and the solid earth sciences. In addition to these formal divisions, CIRES has five internal Centers further facilitating interdisciplinary research. These are the Climate Diagnostics Center, the Center for the study of Earth from Space, the National Snow and Ice Data Center, the Center for Limnology, and the Colorado Center for Chaos and Complexity. CIRES has also recently established a highly interdisciplinary Western Water Assessment program that will closely integrate with NOAA’s existing assessment programs.

As in any other scientific discipline, advances in the environmental sciences result from improved observations, understanding, modeling and prediction. CIRES scientists have made important contributions on all of these fronts during the past year. It is not possible to do justice to all of these topics here but only to highlight some of the more interesting developments. The attached list of Journal Publications by CIRES scientists and should be helpful in assessing the full extent of these contributions. External recognition is also detailed in the attached list of Awards received by CIRES scientists.

The integral links between the NOAA labs and the University of Colorado through CIRES ensure an efficient ‘transfer of science’ and fulfill an important educational goal. CIRES is also continuing to develop its K-12 Outreach Program that has already been recognized as exemplary of its kind. Ongoing projects include professional development for K-12 teachers, classroom presentations for students, mentoring and partnership programs with teachers and students, and undergraduate course development for pre-service teachers at the University. The attached Community Service and Outreach supplement should give an idea of the breadth of these activities by CIRES personnel.
As we enter the 21st century, the development of environmental policies will increasingly rely upon science as an important input in the complex process of decision-making. CIRES takes seriously the role of science in its service to society, and in addition to broadening its educational function through its outreach programs, is moving toward facilitating meaningful interactions between ‘natural’ scientists and social scientists, political scientists, economists, lawyers, and others involved in decision-making.

Some notable CIRES contributions over the past year (July 1999 – June 2000) are summarized below, under the broad NOAA themes of

- Health of the Atmosphere (and Biosphere)
- Climate variability and Global Change
- Integrated Assessments (including Water in the Interior West)
- Polar Science (including Polar Stratospheric Ozone Depletion)
- Earth Observing Systems

We stress again that this is not a comprehensive catalogue. Also, some of the contributions do not fit neatly under any single theme above and could be included under multiple themes,

**Health of the Atmosphere (and Biosphere)**

- Together with scientists at NASA, researchers at the Aeronomy Lab have shown that total chlorine is beginning to decrease at stratospheric altitudes above 30 km, responding to previously reported changes in surface concentrations of chlorofluorocarbons. The new study therefore represents the first direct evidence that the stratosphere is slowly starting to "heal". Global satellite measurements of hydrochloric acid (which accounts for over 80% of the total chlorine content near the stratopause) were used for this study. Thus, another step can be reported to the United Nations that policy actions taken are having their expected effects.

- Through global measurements of all the important chlorine bearing molecules, CIRES and CMDL scientists have established that troposphere total chlorine peaked in 1994 and is now slowly decaying. This indicates that stratospheric chlorine (and ozone depletion) should begin to decrease by the turn of the century.
• CIRES and CMDL scientists contributed to a paper in Science that described constraints on hemispheric mixing ratios of hydroxyl (OH), a cleanser of many atmospheric pollutants, from troposphere methyl chloroform measurements. Calculations showed that there exists 15 (+10) % more OH south of the mixing barrier between the hemispheres, the Inter-Tropical Convergence Zone (ITCZ), than north of that zone.

• The Aeronomy Lab played a leading role in organizing a major field experiment in the Houston area in summer 2000 (the Texas Air Quality Study), the largest air quality field campaign ever conducted in Texas. The study took the first detailed look at how pollution is affected by the region’s coastal meteorology and the unique mix of vegetation, refineries, and transportation sources of hydrocarbons. Colleagues in several NOAA laboratories participated (ARL, CMDL, ETL, FSL). Findings from the mission are critically needed by Texas air quality managers to design scientifically sound strategies that will enable the region to meet the National Ambient Air Quality Standards.

• Forest fires have long been recognized as an important influence on the quality of air on local and even regional scales. But new research at the Aeronomy Lab has shown that the effect can extend even thousands of miles away, crossing the entire North American continent. In 1995, lightning-induced forest fires in northwestern Canada were at times the largest source of summertime carbon monoxide pollution more than 2000 miles away in the eastern United States. This is a good example of enhanced scientific understanding potentially influencing decision-making in the air quality arena.

**Climate Variability and Global Change**

• Using both long-term observational data and atmospheric GCM simulations, CDC scientists made significant progress in determining the changes to the probability distributions of atmospheric variables during tropical ENSO events, with particular emphasis on the changes of second moments and extreme values. Their generation of very large ensembles of GCM integrations to determine these changes with statistical confidence was a significant and original step in this regard. This turned out to be particularly important, because the character of the anomalous variability differs sharply for the daily, fortnightly, monthly, and seasonal time scales. Perhaps most interesting of all, the results suggest that the seasonal mean climate may not necessarily be more predictable during El Niño than La Niña (as is commonly
thought), because, although the seasonal ENSO signal is larger during El Niño, the noise, that is the uncertainty of that signal, is also larger.

- CDC scientists, in collaboration with NCEP scientists, have investigated the predictability of droughts and floods over the United States through large sets of GCM simulations. In a recently completed study, their focus was on the central U.S. drought of summer 1988 and the floods of spring 1993, and the degree to which they may have been influenced by anomalous SST conditions in the eastern tropical Pacific. The conclusion was that the 1988 drought probably had little to do with the tropical SSTs, but the 1993 floods did.

- CDC scientists have successfully constructed a simple 37-component empirical-dynamical model that can predict wintertime northern hemisphere troposphere circulation anomalies at Week 2 with comparable skill to that of the million-component medium range forecast model in use at NCEP. This success has surprised many researchers and forecasters. One reason may be that the Week 2 extratropical predictability depends strongly on an accurate representation of tropical diabatic heating, which is known to be deficient in the NCEP model. The 37-component model does considerably better in this regard.

- CDC scientists, in collaboration with a CIRES Visiting Postdoctoral Fellow, have made novel use of high-resolution satellite radiance data to identify the distinctly different space and time scales of convective variability over the tropical continents and oceans. The results have important implications for the development of convective parameterization schemes in GCMs.

- CMDL scientists completed an evaluation of the daily, weekly, monthly, and annual variability of the climate-forcing properties of aerosols from 3 years of data at sites in the US and Canada. CMDL scientists also participated in determining the climate-forcing properties of aerosols from southern Asia, as observed over the Indian Ocean from aircraft and a ground site during the 3-month long international Indian Ocean Experiment (INDOEX).
**Polar Science (Including Polar Stratospheric Ozone depletion)**

- Atmospheric Chemistry Project researchers at the Aeronomy lab, and also CIRES scientists at CMDL, contributed to observing and characterizing substantial ozone loss at a single altitude in the wintertime Northern Hemisphere. They participated on the NASA SAGE-III Ozone Loss and Validation Experiment (SOLVE) mission with aircraft and balloon flights from Sweden in the 1999/2000 winter. A suite of ozone-related measurements were made, ranging from large, condensed-nitric–acid-containing particles to long-lived gases that serve as tracers of dynamical motions. These data have been used not only to observe large local ozone losses (greater than 55% at a single altitude) during the mission, but also to understand the effects of temperature on the effectiveness of ozone-depleting chemicals. As a result, the role of unusually cold Arctic winters in ozone depletion in the Northern Hemisphere has been clarified.

- CIRES scientists at the Aeronomy Lab have completed a study demonstrating the role of stratospheric particles as reservoirs of ozone-depleting chemicals. A photoionization laser mass spectrometer onboard the NASA WB-57 high-altitude research aircraft made in-flight chemical analyses of particles above and below the tropopause. These first-of-a-kind data revealed the vertical profiles of the halogen content – fluorine, chlorine, bromine, and iodine – in particles at these altitudes. The results demonstrated that, in calculating the budgets of ozone-depleting chemicals in the lower stratosphere, the halogens stored in the particulate form, as well as the traditional gas phase, must now be accounted for.

- A CIRES scientist in collaboration with NOAA scientists has determined that the ocean is still a net sink for atmospheric methyl bromide, albeit a smaller sink. A paper published in the *Journal of Geophysical Research* showed that low productivity regions of the Atlantic Ocean resulted in a smaller net oceanic sink and that temperature alone could not explain the saturation anomalies observed. A cruise was undertaken this past year to examine the fluxes of other important halogens, including methyl bromide.

- From balloon-borne ozone measurements at the South Pole, CIRES and CMDL scientists have identified several indicators which will allow the healing of the ozone layer in Antarctica to be detected as early as the year 2005 (the ozone hole itself is not expected to disappear until about the year 2050).

- A CIRES scientist in ETL played a major role in the processing and analysis of Atmospheric Surface
Flux Group data (ASFG: a collaborative effort between ETL, CIRES, the Naval Postgraduate School and the Cold Regions Research and Engineering Laboratory), collected during the Surface Heat Flux of the Arctic Ocean (SHEBA) field experiment in the Beaufort and Chukchi Seas from October 1997 to October 1998. This scientist also directed ETL’s participation in the upcoming Swedish-led Arctic Ocean Expedition experiment in the summer of 2001 (AOE-2001). The overall goal of this expedition is to measure and understand the sources and transport mechanisms of aerosols in the high Arctic, and assess the indirect effects of aerosols on climate change in the Arctic.

- CIRES scientists at the National Snow and Ice Data Center (NSIDC) have created a new *State of the Cryosphere* website as an efficient means of delivering information to researchers and the public. The site provides a broad audience with a current and succinct overview of the response of various components of the cryosphere to climate change: how features such as seasonal snow cover, sea ice, mountain glaciers, and the related topic, sea level, are responding to warming.

- NSIDC scientists, with their Russian partners at the Arctic and Antarctic Research Institute in St. Petersburg and also at the University of Washington, have completed an atlas of arctic meteorology and climate information. The atlas contains previously unavailable Russian synoptic meteorology data, newly released historical western drifting station data, and gridded fields of monthly means for six parameters. Scientific applications foreseen for the Atlas data include examining new evidence for climatic change from 1950 through 1990.

- NSIDC has established itself as the primary public source for declassified and unclassified data from both US Navy and Royal Navy submarines. The archive now includes the Submarine Upward Looking Sonar Ice Draft Profile Data and Statistics data set. Trends in the polar ice thickness distribution have been the subject of increasing research interest, with possible connections to global warming.

**Integrated Assessments**

- CIRES and CMDL contributed data and analysis of the trends, distributions, and budgets of trace gases (CO₂, N₂O, CH₄, SF₆, CFCs, HCFCs, HFCs) to the Intergovernmental Panel on Climate Change (IPCC) Assessment for 2000.
CIRES and Aeronomy Lab scientists quantified the radiative impact of two fluorinated compounds, settling a dispute. NF\textsubscript{3} is a major industrial gas used in the electronics industry. C\textsubscript{4}F\textsubscript{9}C\textsubscript{2}H\textsubscript{3} is a potential replacement of ozone-depleting compounds that are now being used as solvents. However, the "greenhouse acceptability" of both was being raised. The atmospheric lifetimes of these species were estimated by laboratory measurement of the parameters needed to calculate their lifetime. Their global warming potentials were calculated using measured IR cross-sections and the calculated atmospheric lifetimes. It was shown that the reaction of O(\textsuperscript{1}D), a very reactive, but low-abundance species, is an important loss process for NF\textsubscript{3}. The lifetime of C\textsubscript{4}F\textsubscript{9}C\textsubscript{2}H\textsubscript{3} was shown to be very short. The atmospheric impact of these two man-made compounds was thus shown to be small, thereby avoiding unfounded restrictions on industry.

Aeronomy Lab scientists contributed to a study of the radiative of climate by troposphere ozone. This study estimated the global distributions of troposphere ozone from the difference between observations of the total column and stratospheric ozone. With these global data, modeling studies placed a new and tighter constraint on the radiative forcing of climate by troposphere ozone. The results of this study are cited in the forthcoming IPCC 2000 assessment as raising the level of scientific understanding of troposphere ozone forcing from "low" to "medium", which is international recognition of a step forward.

Large uncertainties exist in our understanding of the magnitude and mechanisms of carbon dioxide transfer between the air and sea, restricting our ability to model global change. To help settle this issue observationally, CIRES and ETL scientists participated in three distinct direct gas flux measurement campaigns over the Atlantic, Indian and tropical west Pacific oceans on board NOAA’s Ronald H. Brown in the summers of 1998 (Gas Ex-98) and 1999 (Jasmine and Nauru 99) respectively. These cruises yielded the first direct covariance carbon dioxide flux measurements over the open ocean. The measurements were also unique in allowing the CO\textsubscript{2} flux to be estimated as a function of wind speed. The Gas Ex-98 measurements have been utilized to make improvements to bulk gas flux parameterizations and to estimate the global oceanic uptake of CO\textsubscript{2}. 
Water in the Interior West

The NOAA-CIRES Western Water Assessment (WWA) is an innovative interdisciplinary program linking climate variability and water resources to societal needs. As such, the project is also helping to define and justify the development of NOAA’s Climate Services initiative. The WWA is focused on the Interior West, a region around Colorado in which abundant montane precipitation sustains surface flows across semi-arid plains in which water is intensively managed. The program calls for integration of the knowledge of climate variability, hydrology, biology, economics, demography and environmental law in reaching informed decisions on local water management and water use policies.

During the past year, the program has been concerned with assessments of the regional hydroclimatic variability and predictability, water needs, and water quality, and their implications for water management. Progress has been made on all of these fronts.

- On the hydroclimatic variability and predictability front, the effect of ENSO on climate variability in the region has been clarified. ENSO-related seasonal predictability has been found to be statistically significant but modest, and depend strongly upon location and the time of year. On subseasonal time scales, however the feasibility of making improved predictions of runoff using dynamical forecast models has been demonstrated in a study of the Animas River Basin, a small mountain watershed in southwestern Colorado.

- The Interior West is experiencing unprecedented population growth and economic development, resulting in stress on both the quantity and quality of the available water. A pilot project study of the vulnerability of the South Platte River Basin to climate variability has yielded interesting insights. For example, with increasing urbanization, one might expect the regional vulnerability to decrease as the climate-sensitive sectors of agriculture and forestry decline in importance. This overlooks the fact, however, that in the absence of new water sources, increasing urbanization forces a more efficient use of the available water, and generates a tight “water market” (i.e. the volume of water transfers and their prices) that becomes increasingly vulnerable to even minor climate variations.

- WWA scientists in the Center for Limnology have completed an analysis of the connection between climate variability, runoff, and water quality in the South Platte, a river used extensively for irrigation and
municipal supply. The analysis shows that climate variability, which presently is not taken into account in the issue of wastewater discharge permits, has a potential to alter the available dilution of waste in ways that cannot be anticipated from the recent hydrologic record. This makes it likely that at present some wastewater discharge permits are too restrictive, and others are not restrictive enough.

Earth Observing Systems

- CIRES and NOAA scientists have collaborated on research related to the use of the Global Positioning System (GPS) bistatic signal reflections for remote sensing of sea state or wind speed, soil moisture and ice conditions. The work indicates that GPS reflectance mapping has great potential to provide information on the ocean near-surface wind conditions, presence and condition of sea and fresh-water ice, as well as the freeze/thaw state of frozen ground or soil moisture. GPS receiving systems are small and light weight, and particularly well suited to be deployed on aircraft and balloons. In addition, GPS reflectance operates at L-band and with bistatic geometry, characteristics that are not provided by existing passive microwave systems and satellite radar. Thus, the GPS observations could revolutionize remote sensing systems for monitoring ocean, ice and soil moisture conditions. This technique is novel and requires further modeling efforts and experimental verifications. It is state-of-the-art research that is relevant to NOAA's environmental monitoring mission.

- Methods to infer cloud microphysical properties, such as hydrometeor sizes and mass content using combined millimeter wave radar and infrared and microwave radiometry have been developed and refined. Thanks to the CIRES/NOAA leadership in this area, these methods are employed to measure cloud properties remotely from the ground in the various programs that seek to understand the impact of clouds on climate change, including DOE/ARM, NASA/FIRE, and NSF/SHEBA. The methods will also be applied from space in the CLOUDSAT project.

- CIRES and ETL continue collaborative work to develop and apply advanced radar-observing systems. A Memorandum of Agreement is in place to jointly use NOAA's Platteville Radar Observatory as a multi-sensor facility, both for atmospheric research and for new observing technique development.

- An airborne sampling system for routine, in-situ measurements of vertical profiles of aerosol radiative properties has been developed and deployed for remote aircraft operation by CIRES and CMDL.
scientists. The instrument package does not require a technician in the field, and data are rapidly processed and displayed on the web semi-automatically at remote airports.

- In a joint effort, scientists at CIRES, ETL, and NCAR combined state-of-the-art, high-resolution Large-Eddy Simulation (LES) with clear-air electromagnetic scattering theory, resulting in the first synthesis of wind profiler signal time series on the basis of LES data. This new simulation technique will help engineers and scientists to optimize both design and employment of future wind profiler systems for atmospheric research and monitoring.
JOURNAL PUBLICATIONS BY CIRES SCIENTISTS
January 1999 - December 1999

1. Abdalati, W., K. Steffen, Accumulation and hoar effects on microwave emission on the Greenland ice sheet dry snow zones, J. Glaciology, 44(14), 523-531, 1999.


28. Bergman, J.W., Shortwave radiative transfer through complex cloud distributions with the

29. Bergman, J.W., Seasonal variations of clouds in the east Pacific as simulated by the NCAR

30. Bhattacharyya, J., S. Gross, J. Lees, M. Hastings, Recent earthquake sequences at Coso:
evidence for conjugate faulting and stress loading near a geothermal field, Bull. Seis. Soc. Amer.,

broadband regional waveforms for crustal structure in the western United States, Bull. Seis. Soc. Am.,

Rayleigh Optical Depth Calculations, Journal of Atmospheric and Oceanic Technology, 16, 1854 -
1861.

Geologic setting, field survey and modeling of the Chimbote, Northern Peru, tsunami of 21 February 1996,

the measurement of the spectral response of GMS-5 water vapor channel. J. Atmos. Oceanic
Technol., 16, 1851-1853.

vapor measurements using the NOAA mini-MOPA Doppler lidar,” Proceedings of 10th Biennial

F.C. Fehsenfeld, Particle formation and growth in the plumes of coal-fired power
plants, Fall AGU meeting, San Francisco CA: 1999.

37. Brown, Steven S., Ranajit K. Talukdar and A. R. Ravishankara, Reconsideration of the rate

38. Burdge, J.R., D.L. MacTaggart, S.O. Farwell, Realistic detection limits from confidence

Coefficient from Halocarbon Disequilibria, Eos, transactions, Am. Geophys. Union, Spring
Meeting, 80 (17), 46.

1999, Seasonal and Temporal Variability in the Distribution of Methyl Bromide in the Surface
Ocean, IUGG XXII General Assembly, A, 111.


176. **Liebmann, B., G. N. Kiladis, J. A. Marengo, T. Ambrizzi, and J. D. Glick**, 1999: Submonthly Convective Variability over South America and the South Atlantic Convergence Zone. *J. Climate, 12*, 1877-1891.


181. **Marson I., Velicogna I.**, 'Flexural Isostasy in Italy'. 2nd Italian Forum of earth science, Bellaria (Rimini), 20-23 September 1999, p 555. [In Italian].


232. Ralph, F. M., D. Kingsmill, P. Neiman, P. O. G. Persson, A. White, and W. D. Neff, 1999: Comparison of VAD wind profiles from NEXRAD with data from the CALJET coastal wind


263. Serke, D.J., A.J. Gasiewski, M. Klein, V. Leuski, A. Francavilla, J. Piepmeier, I. Corbella, Processing and initial comparison of PSR data from CAMEX-3 to SSM/I and TMI data, AGU, 1999 Fall meeting.


277. Smith, D.F., A.J. Gasiewski, M. Klein, J. W. Bao, H.W. Kroehl, Full potential of satellite microwave data in numerical weather prediction models in all cloud conditions, AGU, 1999 Fall meeting


33


332. Wolter, K., 1999: Quality Control in Recent and Pending COADS Releases. Invited Speaker at WMO Workshop on Advances in Marine Climatology, Vancouver, Canada, September 1999, pp. 312-318.


Honors and Awards - 1999

AVERY, Susan K.  
University of Colorado Robert L. Stearns Award, 1999

BARRY, Roger G.  
Fellow, American Geophysical Union, 1999

BILHAM, Roger  
Graduate School, Faculty Fellowship, 1999

CHESIRE, Laura K.  
Received NASA award for On-Line Communication Competition, Distinguished Technical Communication and Best of Show  
CIRES Member’s Council Award - 1999

DICHTL, Rudolph J.  
Received the Antarctica Service Medal from the National Science Foundation and Department of the Navy for Service in Antarctica

FALL, Ray  
Graduate School, Faculty Fellowship, 1999

FREHLICH, Rod  
Elected Fellow of the Optical Society of America

FROST, Gregory J.  
Awarded "Outstanding Paper, 1999" from NOAA Office of Oceanic and Atmosphere Research

FULLER-ROWELL, Tim  
Received the Director's Award from the Space Environment Center

HARRIS, Katherine A.  
Awarded the Max Eaton Prize from the American Meteorological Society

JING, Xiangbao  
Received a Meritorious Work award from the National Weather Service

KINDEL, Bruce  
CIRES Member’s Council Award - 1999

LEWIS, William  
President elect American Society of Limnology and Oceanography

MOORE, Fred L.  
Received NASA Group Achievement award for POLARIS campaigns

OSTROVSKY, Lev A.
Received the *Orson Andersen Distinguished Fellowship* at the Institute of Geophys. And Planetary Phys., Los Alamos National Laboratory

**RUNDLE, John B.**  
Distinguished Visiting Scientist at Jet Propulsion Laboratory

**SCOTT, Michon**  
Received award of *Distinguished Technical Communication and Best of Show* for NASA's Earth Observatory On-Line Communication Competition

**SIEVERS, Robert**  
University of Tulsa, Tulsa, OK. Honored as a Distinguished Alumnus, 1999

**SPETZLER, Hartmut**  
Alexander von Humboldt Foundation, reinvitation for 3 months

**TATARKII, Valerian I.**  
Elected to Fellow, Institute of Physics, OK

**THOMSON, David**  
Received "Outstanding Paper Award" from NOAA Office of Atmospheric Research 1999 competition

**TOLBERT, Margaret**  
Awarded Outstanding Paper Award for Spring AGU 1999, with student Paula Hudson

**VARANI, Annette**  
Awarded *Distinguished Technical Communication and Best of Show* for NASA's Earth Observatory

**WALLOCH, Lynn**  
Awarded Certificate of Appreciation, NOAA/OAR/ERL Joint Institute Program

**WEBSTER, Peter**  
National Science Foundation Special Creativity Award, 1999
Community Service and Outreach - 1999

ANDERSON, David M.
Science Fair judge, Boulder Valley School District
Technical advisor for the James Creek Watershed Initiative, Jamestown CO

ANDREWS, Elisabeth
Science Fair judge, Boulder Valley School District

ARAJO-PRADERE, Eduardo A.
Did the translation, voice over, and coordination with the video production of the Spanish version of the SEC video, "Eyes on the Sun", the Spanish translation of the NOAA's Space Weather Scale

ARGE, Charles N.
Science Fair judge, Boulder Valley School District

BATES, Gary T.
Volunteer at the Boulder Energy Conversation Center

BERGMAN, John W.
Science Fair judge, Burlington Elementary School, Longmont,
and Martin park Elementary School, Boulder
Mathematics e-mentor for 4th grade, Nederland Elementary School

BOYD, Lance
Conducted Project LEARN teacher technology training for K-12 science teachers, Craig CO
Serve as Liaison to Science from CU outreach programs, targeting more than 10,000 students
and 1,000 teachers across metro Denver, Ft. Collins, and Greeley

CHESHER, Laura K.
Volunteer for American Institute for Graphic Arts events

CHURCH, Lee I.
Volunteer for city of Aurora's Morning Star Alzheimer's Daycare Program

CLARK, Martyn P.
Guest speaker at Central High School, St. Paul MN, on climatology

COMPO, Gilbert P.
Science Fair judge, Burlington Elementary School, Longmont; Summitt Middle School, Boulder; and Coal Creek Elementary School, Louisville

CORNWALL, Christopher R.
Volunteer facilitator, Boulder County Health Dept. - OASOS Program (Out and Supporting Our Selves)

COSTA, David M.
Volunteer firefighter and medic, Boulder Rural Fire Department
Volunteer camera operator, Boulder city Channel 8

DAVID, Donald E.
Board of Trustees of Shepherd's School, Inc.
DECLERK, Karen  
Food Bank volunteer, Boulder County AIDS Project (BCAP)  
Member of Boulder Area Human Resources Association  
CIRES Colorado Combined Campaign Coordinator

DELENE, David  
Science Fair advisor, Fairview High School

DELOACH, Valerie  
Volunteer at the Colorado Therapeutic Riding Center

DICHTL, Rudolph J.  
Volunteer at the Boulder Public Library

ENNIS, Christine  
Serve on the NOAA Practical Hands-on Application to Science Education (PHASE) summer program

FETTERER, Florence  
Volunteer for Colorado's Big Brothers/Big Sisters program

FREHLICH, Rod  
Board member, Boulder Village Arts Coalition

FROST, Gregory J.  
Board member, Commerce Children's Center, Dept. of Commerce Boulder campus

GEORGE, Joanne L.  
Treasurer for Calico and Boots, traditional American dance demonstrations

GREEN, Linda J.  
Present training sessions to U.S. West employees  
Training consultant/advisor for Rocky Mountain Chapter of the Alzheimer's Association  
Charter member, International Association for Healing Touch  
Ordained ministerial counselor and facilitator

HARE, Jeffrey E.  
Volunteer instructor at Eldora Special Recreations Program  
Volunteer for State College Area High School - Wyoming 2000 Expedition (environmental field trip)

HARRIS, Katherine A.  
Science Fair judge, Boulder Valley Schools  
Mathematics e-mentor, Eagle Crest Elementary School, Longmont

HARTTEN, Leslie M.  
Mathematics e-mentor, Pioneer Elementary School, Lafayette  
Science advisor, New Vista High School, Boulder

HOBSON, Vinita  
Colorado Ocean Science Bowl Rules Judge

THRASHER-HYBL, Tracy
Denver Rescue Mission volunteer
University Lutheran Chapel volunteer

JOHNSON, Eric L.
Presented educational seminar on remote sensing to the Morgan County Colorado farm cooperative
Presented remote sensing basics course to numerous primary and secondary school teachers
from throughout Colorado

KING, Daniel
Science Fair judge, Burlington Elementary School, Longmont
Judge for 2000 National Ocean Science Bowl

LAURSEN, Sandra
Science Fair judge, Boulder Valley Regional Fair

LYNCH, Amanda H.
Planning and preparation of Earthworks Workshop for school teachers
of earth science

MAPES, Brian
Court-appointed Special Advocate, Big Brothers

MASLANIK, James
Boulder office of Nature Conservancy volunteer

MCKEEN, Stuart A.
Member, Denver Regional Air Quality Council
Assistant coach, Boulder baseball leagues

MCKIE, Julie
Ocean Sciences Bowl volunteer
Denver Museum of Natural History Education collections volunteer

MCLEAN, Bradley
Journey Guide at Colorado Ocean Journey
Coach, local high school track and field events

MILLER, Tim
CIRES co-rep, Colorado Combined Campaign

NISHIYAMA, Randall
Member of CU’s Museum fund raising committee

O’LOUGHLIN, Karen F.
Volunteer to help clear public hiking trails
Volunteer at Grace Lutheran Church, making food for funerals and receptions

OSTROVSKY, Lev A.
Science Fair judge, Ocean Bowl competition
PARKS, Bradley
Science Fair judge, Nederland Elementary
Boy Scout troop leader

RICHARD, Gretchen
Rules judge, National Ocean Sciences Bowl

RUNDLE, Marie
Science Fair judge, Boulder Valley Schools
E-mentor programs
Participant in "Read Across America" Day

SA'MARTINS, Jorge S.
Science Fair judge, National Ocean Sciences Bowl
E-mentor programs, Pioneer Elementary

SAUNDERS, James F. III
Coach for Boulder High School teams, National Ocean Sciences Bowl
Active in low brass section, Boulder High Wind Ensemble

SCOTT, Donna
E-mentor, Ryan Elementary, Lafayette
Science Fair judge, Ryan Elementary
CIRES Members Council

SCOTT, Michon
Volunteer at Denver Museum of Natural History, Earth and Space Science section

SCHUBERT, Robert
University Staff Council softball league committee

SERREZE, Mark C.
Serve as Science Fair judge, Martin Park Elementary

SHERMAN, David M.
Science Fair judge
E-mentoring, St. Vrain School District

SIEVERS, Robert E.
Conducted 3 exhibitions of sculptures within Colorado

SLOAN, Valerie
Participant in Earthworks 1999

SMITH, Lesley
Technical Advisory Panel, National Ocean Science Bowl
Scientific advisor for an Interactive Earth travelling science exhibit

SPETZLER, Hartmut
Visited high school science departments in rural areas to learn how science teaching can be improved and how universities can better adjust to the incoming students
STEVERMER, Amy J.
Volunteer, Ocean Sciences Bowl

STROEVE, Julienne
Contributed images and text for CIRES arctic exhibit, Ocean Journey Aquarium, Denver

SUEPER, Donna
Elementary and middle school Science Fair judge

VERPLANCK, Emily
Serve as Science Fair judge, Crest View Elementary, Boulder

WALLOCH, Lynn
Coordinator for Family-to-Family Program, Boulder County Department of Social Services, for which CIRES was awarded Outstanding Community Donor

WEAVER, Alexandra
Collaborator on proposals to various agencies, submitted by St. Vrain School District

WICK, Gary
Moderator, National Ocean Sciences Bowl

ZHANG, Tingjun
Science Fair judge, Boulder Valley School District