

RESUMÉ
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EDUCATION

B.S. Physical Science, Colorado State University, *with high distinction* 1968
M.S. Meteorology, University of Michigan 1970
Ph.D. Atmospheric Science, Colorado State University 1980

PROFESSIONAL AFFILIATIONS

Staff Scientist, Battelle, Northwest Laboratories 1986-present
Senior Research Scientist, Battelle, Northwest Laboratories 1980-1986
Adjunct Assoc. Prof., Environmental Sciences, Washington State University 1991-present
American Meteorological Society, member 1968-present
Deutsche Meteorologische Gesellschaft, member 1992-present
Österreichische Gesellschaft für Meteorologie, member 1992-present

COMMITTEE APPOINTMENTS

Leader, VTMX slope flow and cold pool technical group 2000-present
National Spray Model and Application Technology Committee 1991-2000
U.S. Rep., Mesoscale Alpine Programme scientific planning committee 1994-1995
DOE Atmospheric Studies in Complex Terrain Program Policy Advisory Panel 1987-1995
Denver Brown Cloud II Technical Committee 1990-1994
AMS Committee on Mountain Meteorology 1988-1994

OTHER PROFESSIONAL ACTIVITIES AND HONORS

Certified Consulting Meteorologist #187, American Meteorological Society 1978-present
Instructor, Summer School on Mountain Meteorology, Trento, Italy Aug. 2003
Chester L. Cooper Mentor of the Year Award, PNNL 2003
Chester L. Cooper Mentor of the Year Nominee, PNNL 2002
Instructor, AMS Short Course on Technical Writing in Scientific Publications and Proposals, Long Beach, CA Feb. 2003
Fitzner-Eberhard Lab Director's Award for Outstanding Contributions to Science and Engineering Education 2001
Visiting Erskine Fellowship, University of Canterbury, New Zealand 2001
Editor, *Journal of Applied Meteorology* 1998-2000
Organizer, Short Course on Applications of Mountain Meteorology, AMS 1998
Organizer, special issue of *J. Appl. Meteor.* on Grand Canyon meteorology 1998-1999
Instructor, AMS Workshop on Atmospheric Processes over Complex Terrain 1988
NATO International Post-doctoral Fellowship 1983
NOAA Presidential Intern 1972-1973

TEACHING

University of Freiburg, Germany	May 2002	Visiting Professor, Meteorological Institute
University of Canterbury, New Zealand	2001	Visiting Professor, Geography Department
Washington State University	1991-present	Meteorology, CE/ES/RP 471/571
University of Berne, Switzerland	Spring 1995	Visiting Professor, Geography Institute
University of Innsbruck, Austria	Fall 1983	Visiting Professor, Meteorology Institute

I have taught an introductory graduate-level meteorology course at Washington State University (WSU) occasionally since 1991 and frequently present university seminars and invited talks at European and U.S. institutions. I have served on M.S. and Ph.D. graduate committees at WSU, University of British Columbia and the University of Utah.

PROFESSIONAL WORK EXPERIENCE

Battelle Northwest Labs Richland, Washington	Staff Scientist 1980-present
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I have been on the Battelle staff since July 1980, initially as a Senior Research Scientist and, after 1986, as a Staff Scientist, the 5th of 6 scientific levels at the laboratory. During this time, I have served as a technical contributor, task leader, and principal investigator or project manager for various atmospheric research projects. My technical contributions include program planning, design and execution of field experiments, analysis and interpretation of data, and publication of research results. I work within a group of six research scientists in a project-structured organization and take responsibility for direction of technical work, mentoring other scientists, writing proposals, managing projects, and setting and monitoring research budgets. I frequently host students, visiting scientists, and university professors on sabbatical leaves, and presently have a number of active collaborations underway.

Following is a list of the key research programs which I initiated or participated in while at Battelle.

DOE Environmental Meteorology Program. I am the principal investigator for two research projects in DOE's Vertical Transport and Mixing Program, entitled "Vertical Transport Mechanisms in Evolving Urban Basin Cold Pools" and "Large-Scale Meteorological Influences on Urban Cold Pools in the Intermountain Basin". In these projects, meteorological mechanisms leading to the formation and breakup of cold air pools are being studied in Utah's Salt Lake Valley using field measurements, data analysis and numerical modeling. I led a field experiment in the Salt Lake Valley in October 2000 studying the role of slope flows in diurnal cold pool formation and destruction in the Salt Lake Valley. As part of this research I designed and ran a perfluorocarbon tracer experiment on a slope southwest of Salt Lake City to elucidate physical processes relevant to cold pool formation. I am collaborating in field studies investigating the roles of drainage flows and turbulent sensible and radiative heat flux divergences in cold pool formation in limestone sinkholes in northern Utah and in the eastern Alps, investigating the effects of warm and cold air advection on wintertime cold pool formation in the Columbia Basin, and determining the effects of wind machines and drainage flows on frost formation in vineyards.

Mountain Meteorology Book. My book, *Mountain Meteorology: Fundamentals and Applications* was published by Oxford University Press in April 2000. The book takes a phenomenological approach to mountain weather, is illustrated by nearly 200 color figures, is available at online and local bookstores, and is being used for training purposes by government agencies. It is also being used as a university textbook and as a reference book by meteorologists and non-meteorologists. The applications chapters include fire weather and smoke management, aerial spraying operations, and air pollution dispersion.

DOE Global Climate Change Program. I was a contributor to a research project that analyzed the

characteristics and meteorological mechanisms leading to the Great Plains low-level jet. In this project I worked with mesoscale and global climate modelers to determine the effect of the low-level jet on moisture transport, cloud formation, and radiative transfer, and their parameterization in global climate models. As a member of the Atmospheric Radiation Measurement (ARM) program's Science Team, I led an effort to develop a tethered balloon radiometric profiling capability for measuring radiative flux divergence in the atmosphere's boundary layer. This work was conducted under my direction with a project team that included mechanical and electronics engineers and involved scientific collaborations with a larger group of university, federal agency, and private industry scientists funded by NSF as part of a consortium working in the Surface Heat Budget of the Arctic Ocean (SHEBA) program. I tested the new instrument in stratus clouds on the coastline of the Arctic Ocean in June 1995.

DOE Atmospheric Studies in Complex Terrain Program. I was a principal investigator in this multi-laboratory research program beginning in 1984. My scientific interests include the evolution of thermally driven wind systems and temperature inversions and their effects on pollutant transport and diffusion. I led investigations into the effects of topography, surface energy and radiation budgets, and atmospheric scale interactions on thermally driven circulations. As part of the ASCOT program, I participated in numerous field experiments, leading efforts to conduct atmospheric tracer experiments, to measure surface fluxes of radiation, heat and moisture in complex terrain settings, and to perform valley mass, momentum, and heat budgets from field data. I participated in analyses and numerical modeling of slope and valley wind systems and have investigated large-scale mountain-plain circulations in the Rocky Mountains and over the Mexican Plateau, wind direction fluctuations in areas of complex terrain, synoptic scale-valley scale wind interactions in the Appalachian Mountains and in the Swiss Mittelland, classification of wind patterns in complex terrain areas using cluster analysis, solar eclipse effects on mountain circulations and cloud cover in the Alps, and temperature structure evolution in Alpine gap flows. I worked with modelers to investigate numerically the initiation and development of mountain-plain and plain-basin wind circulations using real and idealized topography. I also conducted research on the implications of wintertime meteorology on air quality in the Southwestern U.S. within and surrounding the Grand Canyon, looking at airflow through the Grand Canyon, regional thermally driven circulations in the Grand Canyon region, and the destruction of the basin temperature inversion by passing synoptic-scale disturbances. I completed a collaborative effort to investigate the feasibility of performing atmospheric heat balances over mesoscale control volumes using networks of radar profiler/RASSes. I have also led efforts to utilize the U.S. network of radar profilers to make climatological investigations of mountain-plain circulations in the Rocky Mountains. While conducting this investigation we discovered a global tropospheric semidiurnal solar tidal wind system using harmonic analyses of radar profiler wind data obtained from several North American sites.

DOE Atmospheric Radiation Measurement Program Infrastructure. I led an effort to design, procure, install and operate a network of surface energy budget stations at DOE's Global Climate Change research sites. Ten of these Bowen ratio surface energy budget stations are presently in use in the Southern Great Plains. I was responsible for all aspects of this program including scientific coordination with other research programs and investigators.

USFS Topographic Shading. I was the principal investigator in this research project which provided the U.S. Forest Service with new tools to predict the drift of pesticides used in aerial spraying campaigns in national forests. A digital elevation model was developed to simulate the propagation of shadows across landscapes, and a new dispersion model was developed to simulate key features of post-sunrise CBL growth, temperature inversion breakup, and pesticide drift in valleys.

SRP Winter Visibility Study. I led an effort to study the wintertime meteorology and climatology of the Grand Canyon region of Arizona as part of a privately funded research program investigating the effects of a coal-fired power plant at Page, Arizona, on the visibility in Grand Canyon National Park. This work has led to new understanding of the meteorology of basin areas of the western U.S., including the effects of stagnations and recirculations, the breakdown of basin inversions by passing synoptic scale

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disturbances, the forcing of along-canyon flows, and the development of capping inversions above the Grand Canyon.

ARO Slope Wind Structure Experiment. I served as a contributor to a research program for the Army Research Office evaluating the effects of along-valley wind circulations on the development of nighttime drainage flows on valley sidewalls.

EPA Mountain Cloud Chemistry Program. I managed a research program for the Environmental Protection Agency in which the PLUVIUS reactive storm model was applied to gain a better understanding of the physics and chemistry of acidic cap cloud events on summits of the Appalachian Mountains.

EPA Green River Ambient Model Assessment Program. During the years 1980-1985, I served as Technical Leader and, later, as Project Manager of the EPA GRAMA Program. I had primary responsibility for directing research and modeling activities on meteorological processes affecting pollutant transport and diffusion over the oil shale areas of Utah, Colorado, and Wyoming. In this program, I directed work on two new local-scale and mesoscale air pollution models. Models and user manuals were delivered to the U.S. Environmental Protection Agency.

Central Institute for Meteorology & Geodynamics, Vienna, Austria Visiting Scientist, June 2003

With Dr. Thomas Haiden at ZAMG and students and faculty at the University of Vienna and the Vienna Agricultural University, I investigated the formation of cold air pools in Austria's Grünloch sinkhole using data collected collaboratively in 2001-2002 and planned the writing and publication of research results with Austrian investigators.

University of Freiburg, Germany Visiting Professor, May 2002

I taught a short course on mountain meteorology for forestry and hydrology students at the University of Freiburg, Germany, in May 2002 at the invitation of the institutes of meteorology and forest policy.

University of Vienna, Austria Visiting Scientist, Oct 2001

I spent the month of October 2001 visiting the University of Vienna and working with scientists and students at the University of Vienna, the Vienna Agricultural University, and the Central Institute for Meteorology and Geodynamics designing and implementing a research program to study the buildup of temperature inversions in a limestone sinkhole in the eastern Alps, as part of a university practicum. I installed 58 temperature data loggers in a field of limestone sinkholes and am working with students and scientists on interpretation of these and other data, using approaches developed in my previous related research in northern Utah.

University of Canterbury, Christchurch, New Zealand Visiting Professor, Jan-April 2001

I accepted a prestigious Visiting Erskine Fellowship awarded by the board of the University of Canterbury in Christchurch, New Zealand, between January 15 and April 30, 2001. This meritorious award is granted to distinguished international scientists for the purpose of traveling to New Zealand to participate in teaching and research activities at the University of Canterbury. The teaching appointment was made in the department of geography, where I taught the meteorology sections of four undergraduate and graduate geography courses.

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Paul Scherrer Institute, Villigen, Switzerland Geographical Institute, University of Berne, Switzerland	Visiting Scientist, Jul-Nov, 1994 Visiting Professor, Nov 1994-Jan 1995
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I was invited to participate as a U.S. representative in the scientific planning of a major new international mountain meteorology experiment to be conducted in the Alps, called the Mesoscale Alpine Programme. This program is a follow-on to the World Meteorological Organization's ALPEX program. During the program planning phase I participated as a sub-program chairman (for Alpine boundary layers, tracers, and thermally driven flows) and, with other sub-program chairmen, wrote the MAP scientific plan document. During the planning process, to facilitate interactions with other European scientists, I accepted short appointments at the Paul Scherrer Institute and the University of Berne. I taught a short course on mountain and valley meteorology at the University of Berne.

University of Munich, Germany University of Innsbruck, Austria	NATO Post-Doctoral Fellowship 1983 1983-1985 (12 months total)
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I was awarded a NATO post-doctoral fellowship in 1983 to work with investigators at the University of Innsbruck, Austria, and the University of Munich, West Germany, studying the relationships between valley circulations, temperature inversions, and air pollution dispersion. I taught a semester seminar in complex terrain meteorology at the University of Innsbruck in 1984, and during the fellowship activities in 1984 and 1985 I visited investigators and presented seminars at a number of meteorological institutes in the Alpine countries.

Washington State University, Tri-Cities Campus, Richland, Washington	Adjunct Associate Professor 1991-present
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I am an Adjunct Associate Professor of Environmental Sciences at Washington State University. I also hold an appointment to the Graduate Faculty and serve on students' M.S. and Ph.D. committees (also at the University of British Columbia and at the University of Utah). I teach the introductory graduate meteorology course at WSU. The classes are taught at the Tri-Cities Branch Campus and are broadcast to a second classroom on the main campus through a fully interactive video/audio system. I have assisted in the development of an Atmospheric Sciences curriculum as part of the graduate program in Environmental Sciences.

Colorado State University Atmospheric Science Department, Fort Collins, Colorado	Graduate Research Assistant 1974-1980
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I served as a Graduate Research Assistant in the Department of Atmospheric Science, Colorado State University, during the period 1974 through 1980. During this period, I wrote, with Dr. Thomas B. McKee, an NSF proposal to fund my dissertation research on the structure and evolution of temperature inversions in Colorado mountain valleys. The investigation used a combined observational/theoretical approach and resulted in a thermodynamic model of valley inversion breakup able to simulate the time-dependent vertical temperature structure evolution within valleys of differing topography. This research has since received observational and modeling support from scientists in many countries.

Western Scientific Services Inc. Fort Collins, Colorado	Staff Meteorologist 1973-1974
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I served as Staff Meteorologist with WSSI in Fort Collins, Colorado, from 1973 to 1974 with subsequent promotions to Project Manager and Manager of the Data Services Group. My responsibilities included assisting in the data management for a large weather modification project and the management of a network of satellite-linked data collection platforms in the San Juan Mountains.

National Oceanic & Atmospheric Administration Environmental Research Laboratory, Boulder, Colorado	Presidential Intern 1972-1973
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I served as a Research Meteorologist at National Oceanic and Atmospheric Administration's Environmental Research Laboratories in Boulder, Colorado, during 1972 and 1973, where I conducted meteorological investigations of the weather modification potential of specific High Plains cloud systems, and investigated natural precipitation variability in the western United States. I participated in research flights using DC-6 and C-130 aircraft investigating hailstorms, anthropogenic nuclei sources, and upslope cloud systems. I also served as Project Manager for the Boulder Wind Study in which a network of anemometers was established in the Boulder area and special investigations were conducted to determine the climatology of damaging downslope windstorms.

U.S. Air Force Washington, District of Columbia	Weather Officer 1969-1972
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I was a Weather Officer in the U.S. Air Force from 1969 to 1972. By substituting graduate electives, taking a heavy course load, and transferring coursework from Colorado State University I obtained my Master's degree in one year's study at the University of Michigan while attending the Weather Officer's Training Course. Following this university training, I was transferred to Grand Forks Air Force Base, North Dakota, where I analyzed weather charts, prepared and issued terminal, area, and flight weather forecasts, briefed aircrew personnel on present and forecast weather, issued local weather warnings and weather watch advisories, supervised two weather observers in the performance of their duties, performed various management tasks, and prepared a local forecast study on the occurrence of visibility restrictions due to blowing snow. I also completed a radar scope interpretation course, studied satellite meteorology, and completed correspondence courses in weather observing, forecasting, and other topics.

Western Scientific Services Inc. and Colorado State University, Fort Collins, Colorado	Meteorological Technician 1966-1969
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I worked part-time during the school year and full time during the summers as a meteorological technician in a number of complex terrain meteorological research programs for Colorado State University and for Western Scientific Services, Incorporated. During this time I assisted Drs. Rasmussen and Riehl in computing the atmospheric water balance of the Colorado River Basin and participated in the field portions of a project studying snowpack augmentation with snow fences in the central Rocky Mountains. During one summer, I served as the mountain manager for the Chalk Mountain weather observatory (11,000 ft MSL). I participated in the Chalk Mountain, Hoosier Pass, Fremont Pass, Independence Pass and Operation Hailswath programs, maintaining and operating weather instruments. I maintained a network of cloud seeding generators, operated a weather radar and ice nucleus counters, and drove snow caterpillars in winter experiments. I was engaged in data reduction, quality control, and computer programming in addition to the field work.