

CURRICULUM VITAE

OREGON STATE UNIVERSITY College of Oceanic & Atmospheric Sciences

MICHAEL HUGH UNSWORTH

BIRTHDATE:

October 29, 1942

Citizenship: U.S. citizen, born Embleton, England

Current Position: Professor
College of Oceanic & Atmospheric Sciences
Oregon State University
104 Ocean Admin Building
Corvallis, OR 97331-5504
(541) 737-5428
(542) 737-2540 (FAX)
unswortm@coas.oregonstate.edu

EDUCATION

B.Sc. (Honors), Physics, University of Edinburgh, Scotland
Ph.D., Medical Physics, University of Edinburgh, Scotland

ACADEMIC POSITIONS

Lecturer in Environmental Physics, University of Nottingham, England, 1968-1980
Visiting Professor in Agrometeorology, Department of Land Resource Science, University of Guelph, Canada, 1975-1976
Reader in Environmental Physics, University of Nottingham, 1980-1982
Visiting Professor in Botany, North Carolina State University, 1982-1983
Professor of Environmental Physics, University of Nottingham, 1987-1992
Head of Department, Physiology and Environmental Science, Nottingham University, 1991-1992
Dean, Faculty of Agricultural and Food Sciences, Nottingham University, 1991-1992
Professor in Atmospheric Sciences, Oregon State University, 1992-present
Adjunct Professor in Forest Sciences, Oregon State University, 1999-present
Adjunct Professor, Department of Physics, Oregon State University, 2002-present
Visiting Professor, Department of Geography, University of Southampton, UK, 2003
Visiting Professor, NERC Centre for Ecology and Hydrology, Wallingford, UK, 2003

NON-ACADEMIC POSITIONS

Head of Station, NERC Institute of Terrestrial Ecology, Edinburgh Research Station, 1983-1987
Director, Center for Analysis of Environmental Change, 1992-1999

FIELDS OF SPECIALIZATION

Environmental Physics
Microclimatology
Agricultural & Forest Meteorology

HONORS AND AWARDS

Fellow of the Royal Society of Edinburgh, elected 1989
 Gaskell Medal, U.K. Royal Meteorological Society, 1989
 Fellow of the U.K. Institute of Physics, elected 1990

PROFESSIONAL ACTIVITIES

Professional Organizations

American Meteorological Society
 Committee on Biometeorology and Aerobiology (2002-)
 American Geophysical Union
 Royal Meteorological Society
 Council and Education Committee member, 1977-1982
 Chair, East Midlands Section, 1979-82
 Chair, Scottish Section, 1991
 Institute of Physics (UK)
 Chair, Environmental Physics Group, 1988-92
 British Ecological Society
 Council member, 1985-1988
 Royal Society of Edinburgh

Conference Session Chair, Workshop Convener, etc.

Director of NATO Advanced Research Workshop on "Deposition processes at high elevation sites", 1986
 Invited speaker at Prime Minister Thatcher's briefing on the Greenhouse Effect, 1990
 Conference Convener, "Effects of Air Pollution on Agricultural Crops", University of Nottingham Easter School, 1980
 Conference Co-convener, "Forests and the Weather", Royal Society of London, 1985.
 Conference Co-convener, "Resource Capture by Crops", University of Nottingham Easter School, 1992.
 Co-convener, U.S. Air Pollution Workshop, Corvallis, 1999

Committees, Commissions and Boards

UK Natural Environment Research Council (NERC)
 Chairman, Committee on Air Pollution Effects Research, 1986-1989
 Chairman, Working Group on Climatic Impacts Research, 1989
 Member, Atmospheric Sciences Committee, 1989-1992
 Chairman, Terrestrial Initiative in Global Environmental Research (TIGER), 1990-1992
 UK Department of Environment (DOE)
 Chairman, Review Group on Terrestrial Effects of Acid Deposition, 1986-1992
 Member, Review Group on Impacts of Climatic Change, 1990-1992
 Member, Steering Committee for Hadley Centre for Global Climate Modelling, 1990-1992

Royal Society (London)

Member, Royal Society Working Group on Air Pollution, 1976-1977

Member, British National Committee for the World Climate Research Programme, 1988-1990

Member, Royal Society Environmental Research Committee, 1990-1992

Associate Editor, Atmospheric Environment, 1976-present

Specialist Advisor, U.K. House of Lords Science and Technology Committee Inquiry into the Greenhouse Effect, 1987

Member, Working Group on Environmental Research Programmes, U.K. Advisory Council on Science and Technology, U.K. Cabinet Office, 1991-1992

Member, Research Review Committee, Boyce Thompson Institute, Ithaca, NY, 1994

Chair, NASA Science Advisory Group, Joint US/Canada BOREAS Experiment, 1993-2000

Member, International Review Panel, Dutch National Research Programme on Global Air Pollution and Climate Change, 1995

Member, International Project Team, Integrated Regional Climate Change Impacts Assessment, Science & Policy Associates, Washington DC., for the UK DOE Environment Agency, 1996

Member, USDA National Agricultural Air Quality Task Force, 2001-2003

Panel member, USDA CREES Grants Panel, Nov 2003

Panel member, NASA Carbon Cycle Science Grants Panel, June 2004

Panel member, USDA CREES NRI Grants Panel, Sept 2004

PUBLICATIONS

Refereed Journals

Unsworth, M.H. and J.R. Greening, 1970: Theoretical continuous and L-characteristic X-ray spectra for tungsten target tubes operated at 10 to 50 kV. *Physics in Medicine and Biology*, **15**, 621-630.

Unsworth, M.H. and J.R. Greening, 1970: Experimental continuous and L-characteristic X-ray spectra for tungsten target tubes operated at 10 to 50 kV. *Physics in Medicine and Biology*, **15**, 631-642.

Unsworth, M.H. and J.L. Monteith, 1972: Aerosol and solar radiation in Britain. *Quarterly Journal of the Royal Meteorological Society*, **98**, 778-797.

Unsworth, M.H., P.V. Biscoe, and H.R. Pinckney, 1972: Stomatal responses to sulphur dioxide. *Nature*, **239**, 458-459.

Unsworth, M.H. and H.A. McCartney, 1973: Effects of atmospheric aerosols on solar radiation. *Atmospheric Environment*, **7**, 1173-1185.

Biscoe, P.V., M.H. Unsworth, and H.R. Pinckney, 1973: The effects of low concentrations of sulphur dioxide on stomatal behavior in *Vicia faba*. *New Phytologist*, **72**, 1299-1306.

Scott, R.K., S.D. English, D.W. Wood, and M.H. Unsworth, 1973: The yield of sugar beet in relation to weather and length of growing season. *Journal of Agricultural Science*, **81**, 339-347.

Fowler, D. and M.H. Unsworth, 1974: Dry deposition of sulphur dioxide on wheat. *Nature*, **249**, 389-390.

- Fowler, D. and M.H. Unsworth, 1974: Turbulent transfer of sulphur dioxide to a wheat crop. *Quarterly Journal of the Royal Meteorological Society*, **105**, 767-783.
- Unsworth, M.H. and J.L. Monteith, 1975: Geometry of long-wave radiation at the ground. (I) Angular distribution of incoming radiation. *Quarterly Journal of the Royal Meteorological Society*, **101**, 13-24.
- Unsworth, M.H. and J.L. Monteith, 1975: Attenuation of total solar radiation by aerosol over Britain and the Atlantic Ocean. *Quarterly Journal of the Royal Meteorological Society*, **101**, 390-391.
- Unsworth, M.H., 1975: Geometry of long-wave radiation at the ground. (II) Interception by slopes and solids. *Quarterly Journal of the Royal Meteorological Society*, **101**, 25-34.
- Glazier, J., J.L. Monteith, and M.H. Unsworth, 1976: Effects of aerosol on the local heat budget of the lower atmosphere. *Quarterly Journal of the Royal Meteorological Society*, **102**, 95-102.
- Bache, D.H. and M.H. Unsworth, 1977: Some aerodynamic features of a cotton canopy. *Quarterly Journal of the Royal Meteorological Society*, **103**, 121-134.
- Raybould, C.C., M.H. Unsworth, and P.J. Gregory, 1977: Sources of sulphur in rain collected below a wheat canopy. *Nature*, **267**, 146-147.
- Dalrymple, G.J. and M.H. Unsworth, 1978: Longwave radiation at the ground. (III) A radiometer for the 'representative angle'. *Quarterly Journal of the Royal Meteorological Society*, **104**, 357-362.
- Dalrymple, G.J. and M.H. Unsworth, 1978: Longwave radiation at the ground. (IV) Comparison of measurement and calculation of radiation from cloudless skies. *Quarterly Journal of the Royal Meteorological Society*, **104**, 989-997.
- McCartney, H.A. and M.H. Unsworth, 1978: Spectral distribution of solar radiation. I. Direct radiation. *Quarterly Journal of the Royal Meteorological Society*, **104**, 699-718.
- Black, V.J. and M.H. Unsworth, 1979: Effects of low concentrations of sulphur dioxide on net photosynthesis and dark respiration of *Vicia faba*. *Journal of Experimental Botany*, **30**, 473-483.
- Black, V.J. and M.H. Unsworth, 1979: Resistance analysis of sulphur dioxide fluxes to *Vicia faba*. *Nature*, **282**, 68-69.
- Unsworth, M.H., N.W. Shakespeare, A.E. Milner, and T.S. Ganendra, 1979: The frequency of fog in the Midlands of England. *Weather*, **34**, 72-77.
- Steven, M.D. and M.H. Unsworth, 1979: The diffuse solar irradiance of slopes under cloudless skies. *Quarterly Journal of the Royal Meteorological Society*, **105**, 593-602.
- Penkett, S.A., D.H.F. Atkins, and M.H. Unsworth, 1979: Chemical composition of the ambient aerosol in the Sudan Gezira. *Tellus*, **31**, 295-307.
- Leuning, R., M.H. Unsworth, H.N. Neumann, and K.M. King, 1979: Ozone fluxes to tobacco and soil under field conditions. *Atmospheric Environment*, **13**, 1155-1163.
- Black, V.J. and M.H. Unsworth, 1980: Stomatal responses to sulphur dioxide and vapour pressure deficit. *Journal of Experimental Botany*, **31**, 667-677.

- Steven, M.D. and M.H. Unsworth, 1980: The angular distribution and interception of diffuse solar radiation below overcast skies. *Quarterly Journal of the Royal Meteorological Society*, **106**, 57-61.
- Steven, M.D. and M.H. Unsworth, 1980: Shade-ring corrections for pyranometer measurements of diffuse solar radiation from cloudless skies. *Quarterly Journal of the Royal Meteorological Society*, **106**, 865-872.
- Ormrod, D.P., V.J. Black, and M.H. Unsworth, 1981: Depression of net photosynthesis in *Vicia faba* L. exposed to sulphur dioxide and ozone. *Nature*, **291**, 585-586.
- Callander, B.A. and M.H. Unsworth, 1982: Simulation of a line source by a moving-point source of droplets. II. Practice. *Atmospheric Environment*, **16**, 1829-1833.
- Baker, C.K., M.H. Unsworth, and P. Greenwood, 1982: Leaf injury on wheat plants exposed in the field in winter to SO₂. *Nature*, **229**, 149-151.
- Black, V.J., D.P. Ormrod, and M.H. Unsworth, 1982: Effects of low concentration of ozone, singly and in combination with sulphur dioxide on net photosynthesis rates of *Vicia faba* L. *Journal of Experimental Botany*, **33**, 1302-1311.
- Greenwood, P., A. Greenhalgh, C.K. Baker, and M.H. Unsworth, 1982: A computer controlled system for exposing field crops to gaseous air pollutants. *Atmospheric Environment*, **16**, 2261-2266.
- Callander, B.A. and M.H. Unsworth, 1983: Deposition of 30-60 µm diameter droplets in winter wheat. *Agricultural Meteorology*, **28**, 109-127.
- Dollard, G.J. and M.H. Unsworth, 1983: Field measurements of turbulent fluxes of wind-driven fog drops to a grass surface. *Atmospheric Environment*, **17**, 775-780.
- Dollard, G.J., M.H. Unsworth, and M.J. Harvey, 1983: Pollutant transfer in upland regions by occult precipitation, *Nature*, **302**, 241-243.
- Unsworth, M.H., 1984: Evaporation from forests in cloud enhances the effect of acid deposition. *Nature*, **312**, 262-264.
- Unsworth, M.H., V.M. Lesser, and A.S. Heagle, 1984: Radiation interception and the growth of soybeans exposed to ozone in open-top field chambers. *Journal of Applied Ecology*, **21**, 1059-1079.
- Unsworth, M.H., A.S. Heagle, and W.W. Heck, 1984: Gas exchange in open-top field chambers. I. Measurement and analysis of atmospheric resistances to gas exchange. *Atmospheric Environment*, **18**, 373-380.
- Unsworth, M.H., A.S. Heagle, and W.W. Heck, 1984: Gas exchange in open-top field chambers. II. Resistances to ozone uptake by soybeans. *Atmospheric Environment*, **18**, 381-385.
- Unsworth, M.H. and D. Fowler, 1985: Deposition of sulphur in the UK. *Journal of Science in Food and Agriculture*, **36**, 266-267.
- Unsworth, M.H. and R.M. Harrison, 1985: Is lead killing German forests? *Nature*, **317**, 674.
- Unsworth, M.H., 1987: Adding ethylene to injury. *Nature*, **327**, 364-365.

- Cannell, M.G.R., R. Milne, L.J. Sheppard, and M.H. Unsworth, 1987: Radiation interception and productivity of willow. *Journal of Applied Ecology*, **24**, 261-278.
- Fowler, D., J.N. Cape, and M.H. Unsworth, 1989: Deposition of atmospheric pollutants on forests. *Philosophical Transactions of the Royal Society of London*. **B 324**, 247-265.
- Fowler, D., J.N. Cape, J.D. Deans, I.D. Leith, M.B. Murray, R.I. Smith, L.J. Sheppard and M.H. Unsworth, 1989: Effects of acid mist on the frost hardiness of red spruce seedlings. *New Phytologist*, **113**, 321-335.
- Unsworth, M.H. and J.C. Wilshaw, 1989: Wet, occult and dry deposition of pollutants on forests. *Agricultural and Forest Meteorology*, **47**, 221-238.
- Crout, N.J., K. Gregson, and M.H. Unsworth, 1990: TLM: A technique with application in the numerical solution of diffusion problems. *Agricultural and Forest Meteorology*, **51**, 1-20.
- Wiman, B.L.B., M.H. Unsworth, S.E. Lindberg, B. Bergkvist, R. Jaenicke and H.C. Hansson, 1990: Perspectives on aerosol deposition to natural surfaces, interactions between aerosol residence times, removal processes, the biosphere and global environment change. *Journal of Aerosol Science*, **21**, 313-338.
- Manes, F., A. Altieri, P. Tripoda, C.E. Booth, and M.H. Unsworth, 1990: Bioindication study of effects of ambient ozone on tobacco and radish plants using a protectant chemical (EDU). *Annali di Botanica (Rome)*, **48**, 134-149.
- Unsworth, M.H., 1991: Uptake of gaseous pollutants by plants. *Archivum Ochrony Srodowiska*, **2-4**, 7-15.
- Unsworth, M.H., 1991: Air pollution and vegetation: hypothesis, field exposure and experiment. *Proceedings of the Royal Society of Edinburgh*, **B97**, 139-153.
- Wiltshire, J.J.J., C.J. Wright, and M.H. Unsworth, 1992: A new method for exposing mature trees to ozone episodes. *Forest Ecology and Management*, **51**, 115-120
- Wiltshire, J.J.J., C.J. Wright, M.H. Unsworth, and J. Craigon, 1993: The effects of ozone episodes on autumn leaf fall in apple. *New Phytologist*, **124**, 433-437.
- Wiltshire, J.J.J., C.J. Wright, and M.H. Unsworth, 1994: Seasonal changes in water use of ash trees exposed to ozone episodes. *New Phytologist*, **127**, 349-354.
- Unsworth, M.H., 1995: The exchange of trace gases between land and atmosphere: review and synthesis. *Philosophical Transactions of the Royal Society (London)*, **A351**, 413-416.
- Wiltshire, J.J.J., C.J. Wright, J.J. Colls, and M.H. Unsworth, 1995: Effects of heat balance stem-flow gauges and associated silicone compound on ash trees. *Agricultural and Forest Meteorology*, **73**, 135-142.
- Anthoni, P.M., B.E. Law, and M.H. Unsworth, 1999: Carbon and water vapor exchange of an open-canopied ponderosa pine ecosystem. *Agricultural and Forest Meteorology*, **95**, 151-168.
- Anthoni, P.M., B.E. Law, M.H. Unsworth, and R.J. Vong, 2000: Variation of net radiation over heterogeneous surfaces: measurements and simulation in a juniper-sagebrush ecosystem. *Agricultural and Forest Meteorology*, **102**, 275-286.

- Law, B.E., M. Williams, P.M. Anthoni, D.D. Baldocchi, and M.H. Unsworth, 2000: Measuring and modeling seasonal variation of carbon dioxide and water vapor exchange of a Pinus ponderosa forest subject to soil water deficit. *Global Change Biology*, **6**, 155-158.
- Williams, M., B.E. Law, P.M. Anthoni, and M.H. Unsworth, 2001: Use of a simulation model and ecosystem flux data to examine carbon-water interactions in ponderosa pine. *Tree Physiology*, **21**, 287-298.
- Law, B.E., A.H. Goldstein, P.M. Anthoni, J.A. Panek, M.H. Unsworth, M.R. Bauer, J.M. Fracheboud, and N. Hultman, 2001: CO₂ and water vapor exchange by young and old ponderosa pine ecosystems during a dry summer. *Tree Physiology*, **21**, 299-308.
- Anthoni, P.M., M.H. Unsworth, B.E. Law, J. Irvine, D.D. Baldocchi, S. Van Tuyl, and D. Moore, 2002: Seasonal differences in carbon and water vapor exchange in young and old-growth ponderosa pine ecosystems. *Agricultural and Forest Meteorology*, **111**, 203-222.
- Unsworth, M.H., 2003: Future directions in air quality research: Introduction to atmospheric issues. *Environment International*, **29**, 241-243.
- Link, T.E., Flerchinger, G.N., Unsworth, M.H., and Marks, D. 2004. Simulation of water and energy fluxes in an old-growth seasonal temperate rainforest using the Simultaneous Heat and Water (SHAW) model. *Journal of Hydrometeorology*, **5**, 443-457.
- Unsworth, M.H., N. Phillips, T. Link, B.Bond, M. Falk, M. Harmon, T. Hinckley, D. Marks, and K.T. Paw U: Components and controls of water flux in an old growth Douglas fir/ western hemlock ecosystem. In press, *Ecosystems*.
- Link, T.E., Unsworth, M.H., and Marks, D., The dynamics of rainfall interception by a seasonal temperate rain forest. In press, *Agricultural and Forest Meteorology*
- Kurpius, M.R., Irvine, J.I., Schwartz, P.A., Law, B.E., and Unsworth, M.H. Annual carbon exchange along a ponderosa pine chronosequence. Submitted to *Journal of Geophysical Research*, May 2004.

Book Chapters, Conference Proceedings and Reports

- Unsworth, M.H., 1974. Radiation measurements as indicators of natural and man-made atmospheric aerosol. World Meteorological Organization, Special Environmental Report, 423-433.
- Unsworth, M.H., 1975. Variations in the short wave radiation climate of the UK. Proceedings of Conference on UK Meteorological Data and Solar Energy Applications, UK Branch, International Solar Energy Society, 18-36.
- Unsworth, M.H. and D. Fowler, 1976. Field measurements of sulphur dioxide fluxes to wheat. In: Atmosphere-Surface Exchange of Particulate and Gaseous Pollutants. Energy Research and Development Admin. Symposium, 342-353.
- Unsworth, M.H., P.V. Biscoe, and V. Black, 1976. Analysis of gas exchange between plants and polluted atmospheres. In: Effects of Air Pollutants on Plants. Ed. T.A. Mansfield. Cambridge University Press, 5-16.
- Steven, M.D. and M.H. Unsworth, 1979. The radiance distribution of clear and overcast skies. In: Meteorology for solar energy applications. UK Branch of the International Solar Energy Society, Royal Institution, London, 26-36.

- Rowlatt, S., D.V. Crawford, and M.H. Unsworth, 1979. Sulphur cycle in wheat and other farm crops. Proceedings of International Conference on Sulphur in Forage, An Foras Taluntais, Dublin, 1-14.
- Unsworth, M.H., 1980. D. Subject Area: Evaluation of Atmospheric Inputs. I. Dry deposition of gases and particles onto vegetation: A review. In: Methods for Studying Acid Precipitation in Forest Ecosystems. Eds. I.A. Nicholson and I.S. Patterson, 9-15.
- Unsworth, M.H. and H. Bateman, 1980. Radiation records at the University of Nottingham School of Agriculture. In: HELIOS, Solar Energy Unit, University College, Cardiff.
- Unsworth, M.H. and V.J. Black, 1981. Stomatal responses to pollutants. In: Stomatal Physiology. Eds. P.G. Jarvis and T.A. Mansfield. Cambridge University Press, 187-203.
- Unsworth, M.H. 1981. The exchange of carbon dioxide and air pollutants between vegetation and the atmosphere. In: Plants and Their Atmospheric Environment. Eds. P.G. Jarvis and J. Grace, Blackwells, Oxford, 111-138.
- Unsworth, M.H., 1981. Air pollution and plant productivity. In: Physiological Processes Limiting Plant Productivity. Ed. C.B. Johnson, Butterworth, London, 293-306.
- Unsworth, M.H., 1982. Exposure to gaseous pollutants and uptake by plants. In: Effects of Gaseous Air Pollution in Agriculture and Horticulture. Eds. M.H. Unsworth and D.R. Ormrod, Butterworth, London, 43-63.
- Lenzian, K.J. and M.H. Unsworth, 1983. Ecophysiological effects of atmospheric pollutants. In: Encyclopedia of Plant Physiology, 12D, Physiological Plant Ecology IV. Ed. O.L. Lange et al, Springer, Berlin.
- Unsworth, M.H., D.V. Crawford, S.K. Gregson, and S.M. Rowlatt, 1985. Pathways for sulfur from the atmosphere to plants and soil. In: Sulfur Dioxide and Vegetation. Eds. W.E. Winner, H.A. Mooney and R.A. Goldstein, Stanford University Press, California, 375-388.
- Unsworth, M.H., 1987. Principles of microclimate and plant growth in open-top chambers. In: Microclimate and plant growth in open-top chambers, Air Pollution Research Report 5, Commission of the European Communities.
- Unsworth, M.H., 1987. Consequences of cloud water deposition on vegetation at high elevations. In: Effects of Atmospheric Pollutants on Forests, Wetlands and Agricultural Ecosystems. Eds. T.C. Hutchinson and K.M. Meema, Springer-Verlag, Berlin, 171-188.
- Unsworth, M.H. and A. Crossley, 1987. Capture of wind-driven cloud by vegetation. In: Pollutant Transport and Fate in Ecosystems. Eds. P.J. Coughtrey, M.H. Martin and M.H. Unsworth, Blackwell Scientific Publications, Oxford, 125-137.
- Unsworth, M.H. and D. Fowler, 1988. Deposition of pollutants on plants and soils: principles and pathways. In: Air Pollution and Ecosystems. Ed. P. Mathy, D. Reidel, Dordrecht, 68-84.
- Cape, J.N. and M.H. Unsworth, 1988. Deposition, uptake and residence of pollutants. In: Air Pollution and Plant Metabolism. Eds. H. Schulte-Hostede, L.W. Blank, N.M. Darrell and A.R. Wellburn, Elsevier, Amsterdam.
- Milne, R., A. Crossley, and M.H. Unsworth, 1988. Physics of cloudwater deposition and evaporation at Castlelaw, S.E. Scotland. In: Acid Deposition

- at High Elevation Sites. Eds. M.H. Unsworth and D. Fowler, Kluwer Academic, Dordrecht, 299-307.
- Grace, J. and M.H. Unsworth, 1988. Climate and microclimate of the uplands. In: *Ecological Change in the Uplands*. Eds. M.B. Usher and D.B.A. Thompson. Blackwell Scientific Publications, Oxford. 137-150.
- Unsworth, M.H., J.S. Cox, and R.K. Scott, 1990. Impacts on agriculture and horticulture. In: *Mild Wet Winter 1988/89*. Ed. M.G.R. Cannell, Institute of Terrestrial Ecology. Report to UK Department of the Environment 63-88.
- Unsworth, M.H., J.S. Cox, and R.K. Scott, 1990. Impacts on agriculture and horticulture. In: *A Hot Dry Summer (1989) and Mild Wet Winter (1988/89)*. Ed. M.G.R. Cannell, Institute of Terrestrial Ecology. Report to UK Department of the Environment 107-136.
- Unsworth, M.H., 1990. Hazards to Productivity - the changing risks of crop losses. In: *The Greenhouse Effect and Primary Productivity in European Agro-ecosystems*. Eds. J. Goudriaan, H. van Keulen and H.H. van Laar. PUDOC Wageningen 16-17.
- Goudriaan, J., and M.H. Unsworth, 1990. Implications of increasing carbon dioxide and climate change for agricultural productivity and water resources. In: *Impact of Carbon Dioxide, Trace Gases and Climate Change on Global Agriculture*. Eds. B.A. Kimball, N.J. Rosenberg and L.H. Allen. American Society of Agronomy Special Publication 53. 111-130.
- Unsworth, M.H. and K. Bardell, 1991. Agriculture and horticulture. In: *Summer of 1990*. Ed. M.G.R. Cannell, Institute of Terrestrial Ecology. Report to UK Department of the Environment.
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- Colls, J. and M.H. Unsworth, 1992. Air pollution interactions with natural stressors. In: *Air Pollution and Biodiversity*. Eds. J.R. Barker and D.T. Tingey, Van Nostrand Reinhold, New York, 93-108.
- May, R., H. Fish, M.H. Unsworth, J. Pyle, G. Randall, and R. Aspinwall, 1992. Environmental Research Programmes, UK Advisory Council on Science and Technology (ACOST), HMSO, 64 pp.
- Unsworth, M.H., R.K. Scott, J.S. Cox, and K. Bardell, 1993. Impacts on agriculture and horticulture. In: *Impacts of the Mild Winters and Hot Summers in the U.K. in 1988-1990*. Eds. M.G.R. Cannell and C. Pitcairn. UK Department of the Environment, HMSO, London, 127-139.
- Unsworth, M.H. and J. Fuhrer, 1993. Crop tolerance to atmospheric pollutants. In: *International Crop Science I*. Eds. D.R. Buxton et al., Crop Science Society of America, Madison, WI., 363-370.
- Unsworth, M.H. and P.G. Geissler, 1994. Results and achievements of the European Open-top Chamber Network. In: *Effects of Air Pollution on Agricultural Crops in Europe*. Eds. H.J. Jager, M.H. Unsworth, L. de Temmerman and P. Mathy, Report No. 46, Environmental Research

- Programme, Commission of the European Communities, Brussels, Belgium, 5-22.
- Unsworth, M.H. and J.J. Colls, 1994. Air pollution - what's in it for crops? In: Resource Capture by Crops. Eds. J.L. Monteith, R.K. Scott, and M.H. Unsworth, Nottingham University Press, Nottingham, England, 189-209.
- Unsworth, M.H., J.J. Colls, and G.E. Sanders, 1994. Air pollutants as constraints for crop yields. In: Physiology and Determination of Crop Yield. Eds. K.J. Boote, T.R. Sinclair, J.M. Bennett and G.M. Paulson, American Society of Agronomy, Madison, WI., 467-486.
- Kocabas, Z., J.C. Craigon, R.A.C. Mitchell, J.N. Perry, G.J.S. Ross, and M.H. Unsworth, 1994. Sensitivity of the AFRC Winter Wheat Model to Changes in Temperature and Radiation. In: Resource Capture by Crops. Eds. J.L. Monteith, R.K. Scott and M.H. Unsworth, Nottingham University Press, Nottingham, England, 420-423.
- Colls, J.J., J.J.J. Wiltshire, C.J. Wright, and M.H. Unsworth, 1995. Growth of Field-grown Ash Trees (*Fraxinus excelsior*) exposed to Ozone Episodes: an Overview. In: Proceedings, 5th International Symposium on Acidic Deposition, Gothenburg, Sweden, June 1995.
- Heinsch, F.A., M.H. Unsworth, and D. Marks, 1995. Modeling feedback between transpiring vegetation and the atmosphere. Abstract, AGU Winter Meeting, San Francisco, CA.
- Unsworth, M.H. and G. Wolfe, 1995. Current progress in the study of global biogeochemical cycles. In: Climate Change Research: Evaluation and Policy Options. Eds. S. Zwerver, M.M. Berk and R.S.A.R. van Rompaey, Elsevier Science, Amsterdam, 9-25.
- Anthoni, P.M., B.E. Law, M.H. Unsworth, D.D. Baldocchi, and T.L. Crawford, 1996. Energy budget of a mature ponderosa pine forest in the Metolius River Valley, Oregon. Abstract, AGU Winter Meeting, San Francisco, CA.
- Unsworth, M.H. and W.E. Hogsett, 1996. Combined effects of changing CO₂, temperature, UV-B and O₃ on crop growth. In: Global Climatic Change and Agricultural Production: direct and indirect effects of changing hydrological, soil and plant physiological processes. Eds. D. Norse and W.G. Sombroek, John Wiley, London, 171-197
- Law, B.E., P.M. Anthoni, D.D. Baldocchi, and M.H. Unsworth, 1998. Below-canopy and Nocturnal CO₂ Fluxes in a Ponderosa Pine Forest. Abstract, AMS 23rd Conference on Agricultural and Forest Meteorology, Albuquerque, NM.
- Unsworth, M.H. and A. Fairbrother, 1998. Global Climate Change: opportunities for the veterinary profession. Extended Abstract, Convention Notes, 135th Annual Convention, American Veterinary Medical Association, Schaumburg, IL., 768-770.
- Anthoni, P.M., Unsworth, M.H., Law, B.E., Irvine, J.I., Baldocchi, D.D., Kolle, O., Knohl, A., and Schultze, E-D. 2002. Comparison of open-path and closed-path eddy covariance systems. Extended abstract, AMS 25th Conference on Agricultural and Forest Meteorology, Norfolk, VA.
- Unsworth, M.H., B.J. Bond, A.C. Mix, T.G. Pypker and L. Mahrt 2004 Nocturnal air drainage in forest canopies: a new way of studying physiological responses to the weather? Extended abstract, AMS 26th Conference on Agricultural and Forest Meteorology, Vancouver, British Columbia.

Pypker, T.G., B.J. Bond and M.H. Unsworth. 2004 The role of epiphytes in the interception and evaporation of rainfall in old-growth Douglas-fir forests in the Pacific Northwest. Extended abstract, AMS 26th Conference on Agricultural and Forest Meteorology, Vancouver, British Columbia.

Books

- Unsworth, M.H. and D.P. Ormrod, Editors, 1982. Effects of Gaseous Air Pollution in Agriculture and Horticulture. 32nd Easter School in Agric Sci, University of Nottingham, Butterworths, London.
- Coughtrey, P.J., M.H. Martin, and M.H. Unsworth, Editors, 1987. Pollutant transport and fate in ecosystems. British Ecological Society, 414 pp, Blackwell Scientific Publications, Oxford.
- Unsworth, M.H. and D. Fowler, Editors, 1988. Acid Deposition at High Elevation Sites, 670 pp, Kluwer Academic, Dordrecht.
- Unsworth, M.H., (Chairman) et al, 1988. The Effects of Acid Deposition on the Terrestrial Environment in the United Kingdom. First Report of UK Terrestrial Effects Review Group, 120 pp, HMSO, London.
- Monteith, J.L and M.H. Unsworth, 1990. Principles of Environmental Physics, 2nd edition. Butterworths, London.
- Unsworth, M.H, (Chairman) et al, 1993. Air Pollution and Tree Health in the United Kingdom. Second Report of UK Terrestrial Effects Review Group, HMSO, London.
- Monteith, J.L., R.K. Scott, and M.H. Unsworth, 1994. Resource Capture by Crops, Nottingham University Press, Nottingham, England.
- Heck, W.W., Chappelka, A., Hunt, W.F. Innes, J.L., and Unsworth, M.H.(Editors) (2003) Future Directions in Air Quality Research : Ecological, Atmospheric, Regulatory/Policy/Economic, and Educational Issues. Environment International, Special Issue, Volume 29, 123-413, Elsevier Science.

TEACHING AND ADVISING

Student Thesis Advisor at Oregon State University

Faith Ann Heinsch, M.S., Atmospheric Sciences, 1997
 Peter Anthoni, Ph.D., Atmospheric Sciences, 1999
 Timothy Link, Ph.D., Environmental Science, 2001
 Christopher Walsh, Ph.D. Environmental Science
 Thomas Pypker, Ph.D. Forest Science

Student Advisory Committees

Diana Sinton, Ph.D., Geosciences, 1996
 James F. Weigand, Ph.D., Forest Science, 1997
 Beverly Wemple, Ph.D., Geosciences, 1998
 Xan Augerot, Ph.D., Geosciences, 2000
 Jennifer Goodridge, M.S., Botany and Plant Pathology, 2001
 Jean-Christophe Domec, Ph.D., Forest Products and Forest Science, 2002
 John Moore, Ph.D., Forest Resources, 2002
 Deana Pennington, Ph.D., Geosciences, 2002
 Clifton Cooper, Ph.D., Environmental Sciences
 Cheryl Klipp, Ph.D., Physics, 2003

Reina Nakamura, Ph.D., Atmospheric Sciences
 William Russell, Ph.D., Forest Science, 2003
 Georgianne Moore, Ph.D., Forest Science, 2003
 Julian Licata, M.S., Forest Science, 2003
 Michael Conway, Ph.D. Crop and Soil Science
 Julian Licata, Ph.D., Forest Science

Graduate Faculty Status

Graduate faculty member: COAS, College of Forestry (Forest Science), Environmental Science Program, Water Resources Program.

Teach graduate level courses

Serve on thesis committees

Direct masters theses

Direct doctoral programs

Oregon State University Committee Assignments

COAS Promotions and Tenure Committee, 1996 (member), 1999 (chair), 2004 (member)

COAS Faculty Advisory Committee 2000-2001, 2003-2005

COAS Peer Review of Teaching Committee (chair) 2004

COAS Faculty Hiring Consultative Committee 2004-2005

OSU Administrative Appointments Committee (College of Science Dean Search Committee, Vice-president for Research Search Committee), 2000-2003

OSU Graduate Council, 2004 -

Courses Taught at Oregon State University

ATS 564/FS 564, "Atmosphere Vegetation Interactions", 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004

ATS 210, "Introduction to the Atmospheric Sciences", Fall 1999, Winter 1999, Spring 2001, 2002, 2003, Winter 2004

ENSC 515, "Environmental Perspectives and Methods", 1998

ATS 405, Reading and Conference Undergraduate Research Team Projects (Salmon Conservation 1998; Greenhouse Gas Emissions 1999)

ATS 499H Microclimate and Survival (2002)

Summary Student Ratings:

	Course		Excellent	V Good	Good	Fair	Poor
ATS 210	W 2004	Instructor	11	10	6	0	0
		Course	5	16	4	2	0
ATS 564	F 2003	Instructor	4	1	0	0	0
		Course	3	2	0	0	0
ATS499H	W 2002	Instructor	2.5	1	0.5		
		Course	2.5	1.5			
ATS 210	S 2002	Instructor	7	5	7	1	0
		Course	4	9	4	2	0

ATS 564	F 2001	Instructor	7	5	1	0	0
		Course	2	9	2	0	0
ATS 210	S 2001	Instructor	10	8	7	1	0
		Course	5	11	8	1	0
ATS 564	F 2000	Instructor	1	5	0	0	0
		Course	1	4	1	0	0
ATS 564	F 1999	Instructor	6	1	0	0	0
		Course	6	1	0	0	0
ATS 210	F 1999	Instructor	5	11	2	2	0
		Course	2	13	4	1	0
ATS 210	W 1999	Instructor	8	12	5	0	0
		Course	3	12	8	2	0
ATS 564	F 1998	Instructor	6	3	2	0	0
		Course	4	6	1	0	0
ATS 564	W 1997	Instructor	4	5	1	0	0
		Course	3	5	2	0	0
ATS 564	W 1995	Instructor	8	1	0	0	0
		Course	5	4	0	0	0

RESEARCH

Research Grants since 1992

While Director for the Center for Analysis of Environmental Change, "Salmon Conservation," "The Northwest Forest Plan," "Ecosystem Management in Russia," "Training Cooperative with EPA", 1992-1999, \$750,000

Recent Grants for Personal Research

"Evaluating Ecosystem Model Predictions of CO₂ and Water Vapor Exchange Across the Oregon Transect with Flux Measurements from Light Aircraft and Towers," Co-PI Richard Waring, NASA, 1995-1997, \$391,000

"Measurement and Modeling of Soil Moisture in Relation to the Carbon Exchange at the Wind River Canopy Crane Research Facility," Co-PI Danny Marks, DOE (WESTGEC), 1997-2000, \$182,000

"Evaluating Model Predictions of CO₂ and Water Vapor Exchange with Flux Measurements in a Ponderosa Pine Forest," Co-PI Beverly Law, NASA, 1998-2001, \$623,000

"Reducing Uncertainty in Carbon and Energy Exchange Over Pine Forests" Influence of Age, Management and Climate," Co-PI Beverly Law and Larry Mahrt, NASA, 1998-2001, \$841,000

"Regional Analysis of Net Ecosystem Productivity of Pacific Northwest Forests: Scaling Methods, Validation and Results Across Forest types and Age Classes," Co-Investigator Mark Harmon, Warren Cohen, David Turner (Beverly Law, PI), EPA, 2000-2003, \$1,849,000

"Research Equipment for Advective Transfer Studies," Co-PI Larry Mahrt and Beverly Law, OSU Research Office, 1999, \$15,000

"Analysis of Sources and Sinks of Carbon Dioxide: The University as a Microcosm of Society," Environmental Defence Fund, 1999-2000, \$15,000

"Influence of Climate Variability on the Productivity and Distribution of Ponderosa Pine Ecosystems in the Pacific Northwest: Combination of a Process-Based Model and a 102-Year High Resolution Climate Data Set," Co-PI Beverly Law and Richard Waring, NOAA, 2000-2002, \$242,000

"Carbon and Water Vapor Exchange in Successional Stages of Pacific Northwest Forest Ecosystems: Integration of Eddy Flux, Plant and Soil Measurements," Co-PI Beverly Law, DOE, 2000-2003, \$850,000

"Isotope ratios of respired CO₂ as indicators of ecosystem function in small watersheds: a feasibility study." Co-PI with Barbara Bond and Alan Mix. NSF, 2002-2004, \$156,096

"Airsheds, Isotopes and Ecosystem Metabolism in Mountainous Terrain." Co-PI with Barbara bond, Alan Mix and Elizabeth Sulzman. NSF, 2004-2007, \$790,000

"A wireless network of battery-free sensors for atmosphere-biosphere studies in complex environments." Co-PI with Barbara Bond, Tom Dietterich, Terri Fiez, and Huaping Liu. submitted to NSF, \$2,497,967, 2004-2009.

MISCELLANEOUS

Statement of Experience and Qualifications

My experience includes appointments as a faculty member at universities in England, Canada and the U.S., as Head of a government research station in Edinburgh, Scotland, and as Director of the Center for Analysis of Environmental Change, a Research Center based at Oregon State University but also supported by federal and private agencies. I moved through faculty ranks at the University of Nottingham, England, to eventually become a Department Chair, and served as Dean of the College of Agricultural and Food Science before moving to the U.S. in 1992. This career path gave me substantial experience in management in universities and elsewhere, but also helps me to be aware of issues affecting junior faculty. In Edinburgh I was responsible for managing and allocating the research station budget, choosing between new initiatives proposed by scientists, and dealing with personnel and space issues. At Nottingham, as Dean and Department Chair, I worked with a very diverse group of faculty, with interests ranging from computer science to biotechnology, and developed a working knowledge and enthusiasm for many topics outside my areas of specialization. With this wide experience I have regularly served as a member of review groups for many institutes, research programs etc. At the OSU Center for Analysis of Environmental Change, this breadth of interest expanded further, and I worked with many faculty across campus, and scientists in federal and other institutes. This gave me a strong knowledge of many aspects of the on-going environmental research in the Pacific Northwest. Through regular meetings with other Directors of OSU Centers and Institutes, and with Deans of many of the colleges, I am very familiar with wider research strengths in the university. I also gained useful knowledge of the university's budget and accounting systems, particularly as they affect Centers and Institutes.

My personal research has ranged over several topics on the interface between physical and biological systems. My Ph.D. research in Medical Physics was concerned with characterizing ionizing radiation for human subjects. On joining the Environmental Physics group at the University of Nottingham, I developed a research program into effects of atmospheric aerosols (primarily sulfate and natural materials) on visible and infrared radiation at the ground. This work led to an interest in sulfur dioxide deposition and effects, and generated a large research program that subsequently extended to studies of the deposition and effects of ozone, acidic cloud drops, and nitrogen compounds. I also worked on spray drift associated with agricultural pesticides in the UK and the Sudan, and with waste treatment processes. This work was funded by a variety of sources: UK Research Councils, private industry (chemical companies, electricity utilities, oil companies), the European Union, and the U.S. Forest Service (NAPAP Program). While Head of the Institute of Terrestrial Ecology Research Station in Edinburgh Scotland I managed research primarily in Tree Biology, Freshwater Ecology and Air Pollution. Before I left the UK in 1992, my research was moving more to global change issues, particularly effects of climate change on agricultural systems. At Oregon State University, as Director of the Center for analysis of Environmental Change, I was responsible for several multidisciplinary projects concerned with salmon habitat, forest ecosystem management, and greenhouse gas sources and sinks. My personal research at OSU also involves multidisciplinary collaboration, focusing on the carbon and water cycles of old-growth and young forests. This work has been supported by NASA, DOE, NOAA and NSF.

I have served on many national and international committees, and on review groups for research laboratories specializing in environmental, ecological, and biotechnological

research. Examples include: chairing the committee that developed the Science Plan for the UK's Terrestrial Initiative in Global Environmental Change; service on a six-person Working Group appointed by the UK Advisory Council on Science and Technology (reporting to the UK Cabinet Office) to review the scope and balance of all publicly funded environmental research in the UK; chairing the UK Committee on Air Pollution Effects Research; directing the UNECE Program on Air Pollution Effects on Agricultural Crops; and chairing the Science Advisory Team for the joint NASA/ Canadian Research Council BOREAS Program. Other examples are listed under professional activities.