INCREASING USE OF THE *INTEGRATED DATA VIEWER* (IDV) IN THE ATMOSPHERIC SCIENCE CURRICULUM AT THE UNIVERSITY OF MISSOURI-COLUMBIA

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To the

Unidata Program Center and the National Science Foundation

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Project Summary

The computing facilities in the Atmospheric Science Program at the University of Missouri-Columbia (UMC) consist of 3 Windows XP PCs (Dell Pentium IV machines), 14 Unix machines (1 Sun Blade2500 server; 1 Sun Blade150 web server; 5 Sun Blade2000 machines; 7 Sun Ultra5 clients), and 4 Linux machines (1 Dell Precision 470 server; 1 Compaq; 2 locally built machines). The Sun and Linux machines have been organized into the Weather Analysis and Visualization (WAV) laboratory. The Sun Blade2500 is the network server, running the Local Data Manager (LDM) and allowing users to access real-time and archived data via GEMPAK and the *ntl* suite (GARP, NSHARP, etc.), as well as the Integrated Data Viewer (IDV), using the other Sun machines. Other software available on the network includes NCAR Graphics, WATADS, Vis5D, Imagine and MatLab. The Linux machines run in parallel, with the LDM and GARP data access as well as newer software (IDV, WDSS, and the WES). The Windows XP PCs are mostly grouped together in a separate laboratory.

This proposal requests funding to purchase six high-end PCs running Solaris 10 to help replace the aging Sun Ultra5 machines, which are well past their sunset date. This situation has posed a significant instructional problem for our faculty; internal funds for system replacement have not kept pace with the need for upgrades. We have recently received funds ($3,300.00) from UMC to replace our 3 PCs (each 3 years old) and one of our existing Sun Ultra5 machines.

The machines that we hope to acquire would allow continuity in our Sun Unix environment and software offerings. They would also enable rapid access to the IDV on newer computing platforms that are far less expensive. The overarching theme of this proposal is to reinvigorate student use of our WAV lab workstations and the IDV in both teaching and research modes.

1. PRESENT SITUATION

The Atmospheric Sciences Program (ASP) resides in the Department of Soil, Environmental and Atmospheric Sciences (SEAS) and the School of Natural Resources (SNR) at the University of Missouri-Columbia (MU). Within the ASP is housed the Missouri Climate Center (MCC). The ASP was founded in 1961 and grants Bachelor of Science, Master of Science, and Doctor of Philosophy degrees in Atmospheric Science. Currently, there are 90 undergraduate students majoring in atmospheric science as well as 18 graduate students (14 M.S., and 4 Ph.D.); these numbers are up substantially from 60 (undergraduate) and 5 (graduate) in 2000 and have leveled off in the last few years. MU is a charter member of the University Corporation for Atmospheric Research (UCAR). With 3 full-time tenured faculty lines and a part-time instructor, the ASP is a moderately sized program.

Weather stations are maintained by the MCC at the historic Sanborn Field on campus as well as the South Farms site and the Prairie Fork Conservatory area, south and east of campus, respectively. The MCC and the ASP are housed in the Agriculture and Natural Resources buildings, respectively, on the MU campus. Meteorological data in the form of emulated DIFAX are obtained from the University of Wisconsin-Madison via the Local Data Manager (LDM). The LDM also feeds a cluster of 14 Sun Unix machines, which constitute the Weather Analysis and Visualization (WAV) laboratory. Observed data and model output are available in the WAV lab through GEMPAK, the *ntl* suite (GARP, NSHARP, etc), NCAR Graphics, WATADS, Vis5D, and MatLab. IDV usage is problematic in that it will only function well on the Blade2000 machines and Blade2500 server (6 machines total). It will not function on the aging Sun Ultra5 machines, numbering seven, and comprising nearly one half of the computing in the WAV lab.

Additional computing facilities include 4 Linux machines. One is a Dell Precision 470, which serves as a server for a small Linux research cluster and allows use of such software as WDSS and WES. The remaining 3 Linux machines are two locally built machines and a single aging Compaq. Lastly, 3 Windows-based PCs are available for generic use and limited IDV access.

We also note that our Sun Blade150 machine acts as a World Wide Web (WWW) server. This site exists largely for the dissemination of student forecasts, American Meteorological Society-National Weather Association student chapter information, student web pages, graduate student research results, as well as real-time output from National Centers for Environmental Prediction (NCEP) model simulations in **isentropic** coordinates and GEMPAK-format files that offer more of the same (from a previously funded UNIDATA proposal)

2. A DEVELOPMENT PLAN FOR THE UPGRADE OF COMPUTING RESOURCES

Becoming fully functional in terms of IDV usage will require upgrades to our present cluster. It is proposed that the following hardware be purchased for this upgrade:

- **6 computer systems running on 2.8 GHz Dual Core Pentium IV chips and 2.0GB of RAM / 250 GB hard Drive / 19" Flat-panel monitor / mouse / keyboard / nVIDIA 7600GS PCI-E 256 MB after market video card**

The equipment specified by this proposal would completely modernize our Unix laboratory. The Intel-based PC computers specified above would be installed with Solaris 10, thus overhauling completely the power in the WAV Laboratory. Historically, we have used Sun hardware only, a practice that has become cost prohibitive. Yet, the faculty, staff, and students are all quite

acquainted with the Solaris operating system, which is freely available and runs the IDV (as well as the rest of the core software for our lab) on the requested hardware.

2.1 Contributions to Education

We envision a significant impact of the proposed hardware/software in our teaching. The WAV Lab is an interactive classroom, where students can view diagnostic and prognostic meteorological fields in a windowed display. Our courses typically have about eight to twelve students, which means one to two students per computer in class. Over the course of the academic year, students will have ample time to use the workstations in an unstructured environment in order to explore the particulars of the software. The following courses in our Program will greatly benefit from the new equipment in the manner described below.

a. Synoptic Meteorology I/II (Junior level)

For real-time map discussions, skew-T analysis, isentropic analysis, Q-G theory interpretation, calculation of convective parameters, comparing numerical models, satellite imagery analysis, and the like, the *ntl* suite (especially GARP) is used extensively. Only ~1/2 of the machines in our WAV Lab currently have the power to run the IDV efficiently; we seek to change this.

b. Dynamic Meteorology and Thermodynamics (Senior level)

Students will have a greater freedom to calculate vertical motion, vorticity tendencies, and other diagnostic quantities. This equipment permits the development of barotropic and baroclinic models to explore barotropic and baroclinic instability. Finite differencing techniques can be studied. GEMPAK provides an ideal framework for the exploration of these topics.

c. Mesoscale Meteorology and Dynamics (Senior / Graduate level)

In addition to in-class examples and homework sets, students are required to perform a detailed case study of a given mesoscale event as a part of their grades, beginning at the synoptic scale with conventional data and progressing downscale to the analyses of individual storm cells using radar (reflectivity and velocities) and satellite imagery. The IDV and GARP provide the ideal tools for the analysis of these observed data.

d. Weather Briefing (Freshman / Sophomore level)

An introduction to surface and upper air analysis, satellite imagery, profilers, and RADAR will be made to this class using the IDV and GARP, which are particularly well-suited to incoming freshmen, as data are readily accessed using mouse-driven icons and pull-down menus. The proposed hardware for the WAV Lab would be invaluable to this course, as it could then return to that room. Currently, Weather Briefing students must use Web based analyses on in a generic campus PC lab to do briefings. Although Web access of rasterized images is convenient and expedient, students do not manipulate data in the process, which sets low expectations on them as students at the outset of their academic careers.

e. Weather Analysis and Forecasting (Senior level)

As we continue to develop our forecasting class, the use of the proposed hardware/software will be invaluable. A quasi-operational approach to real-time forecasting problems and the composition of National Weather Service-style Area Forecast Discussions by student forecasters underscores the need for the proposed hardware. See also *Synoptic Meteorology I/II (Junior level)* above.

f. Radar Meteorology (Junior/Senior level)

The IDV will allow students to view radar data in its natural orientation giving them a better understanding of where the atmosphere is sampled by the radar relative to the surface. It will also allow them to explore the how the radar observations are related to other meteorological fields produced by model. For example, Doppler velocity fields can be compared to model winds to illustrate differences in sampling and structure scale.

The introduction of more high-end hardware which can take full advantage of the features in the IDV will also benefit continued development of a weather forecasting laboratory, which will use both "canned" and real-time case studies for forecast analysis and exploration of forecasting techniques. It is important also that students integrate lecture material with actual data and modeled output in order to help them visualize atmospheric processes in two and three dimensions. Moreover, it is critical that students learn how to use modern "tools of the trade" in meteorology, software that they may be using in many aspects of the profession.

The ASP will continue to strive to illustrate conceptual models and ideas using the request workstations. Finally, it is expected that students will want to explore the use of this equipment outside of class time.

2.2 Contributions to Research

The PI's existing COMET Partner's activities with NWS offices in Springfield, MO (SGF), and New Braunfels, TX (EWX), as well as our proposed Cooperative work with SGF and Little Rock, AR (LZK), would benefit from the enhanced ability to exchange data. Market is a recipient of a NSF CAREER grant, the design for which demands extensive student forecasting, using the *ntl* software suite as well as the IDV to access data as well as NCEP and local model simulations. Adding the proposed hardware will permit broader access to all of the available data by a greater number of student and faculty researchers.

2.3 Contributions to the UNIDATA Community Capability

The University of Missouri has been involved with UNIDATA since the early 1990's. The University is also a UCAR member. With the acquisition of new equipment, the Program representatives will need to attend UNIDATA or UCAR sponsored workshops in order to more effectively understand and use the IDV. We are members of the GEMPAK e-mail lists in order to participate more fully by communicating with our fellow UNIDATA institutions. Through this process, we can also relate our experiences using UNIDATA products in the classroom with our

fellow institutions and UNIDATA. Our program will continue to support UNIDATA's efforts in whatever capacity (and in an expanded capacity) is available to us.

We will disseminate the results of our projects and UNIDATA activities via the following avenues:

a. Real-time and archived isentropic data sets

Presently, we continue to serve as an outlet for web-based analyses of model-derived isentropic fields (http://weather.missouri.edu/isen). Many professors teach their students about the benefits of isentropic analysis techniques. Yet, after a few "canned" case studies, students rarely have an opportunity to continue with the practice of analyses in θ-space. Our web portal hosts real-time analyses of model fields in isentropic coordinates, as well as archived isentropic files from the NAM and NGM model solutions in GEMPAK format.

b. Preprint and journal articles

Those that are published by the AMS, RMS, or NWA, (see appended curriculum vitae).

c. COMET partners and cooperative project reports

These reports emphasize the use of UNIDATA software as tool in research.

e. Laboratory manuals

These manuals show our students how to access meteorological data in an X-window or similar display environment. Also, our program will gladly share any products we develop with other institutions. Our program will also make available our datasets to other institutions via the Web.

e. Script files

Our program has developed GEMPAK script files to make teaching and research applications much easier. For example, we have developed several scripts, which create isentropic versions of NGM and Eta model gridded output files. We will gladly share these and any other scripts we develop with the UNIDATA community.

3. SYSTEM MANAGEMENT COMPETENCE

Dr. Patrick S. Market, the principal investigator of this proposal, and Drs. Anthony R. Lupo and Neil I. Fox, project co-directors, are all well acquainted with Unix- and Linux-based systems and peripherals. The investigators also possess considerable experience using Sun workstations, and various X-window environments in their research. They also have considerable expertise in using the IDV, GEMPAK, and the *ntl* suite, and have developed GEMPAK scripts in their research work. Dr. Market supervises the existing WAV Lab network, while training students and other faculty in the use of the machines, their windowing environment, and the UNIDATA software suite. He has considerable experience with the implementation and use of mesoscale models, as well as various visualization packages (esp. GEMPAK and Vis5d). Dr. Lupo has been the UNIDATA contact

point for the University of Missouri since 1998. Dr. Fox has an extensive background in the processing of remotely sensed data in a Unix/Linux environment. Their resumes are found at the end of this document.

The School of Natural Resources, of which the Atmospheric Sciences Program is a part, has a computer systems engineer who provides maintenance, largely for the Program PCs. Additionally, the services Mr. Eric Haug, system engineer for the Earth and Atmospheric Science Department at Saint Louis University, is retained by the MU ASP on a contract basis because of his years of experience with meteorological computing applications in a Unix environment.

In closing, we have complete confidence that the proposed hardware will be well-deployed and facilitate a necessary upgrade to our present computer resources. This proposal will enhance the computing environment at the University of Missouri at this crucial stage of the Atmospheric Science Program's rapid growth.

4. BUDGET AND JUSTIFICATION

A breakdown of the actual computer equipment and peripherals follows and includes a 20% discount available to our educational institution:

6	**PCs running on 2.8 GHz Dual Core Pentium IV chips and 2.0GB of RAM / 250 GB hard Drive / 19" Flat-panel monitor / nVIDIA 7600GS PCI-E 256 MB Video Card** (Local PC system builder) @ $1,300 each	$7,800.00
	Total Direct Costs	**$7,800.00**
	Indirect Costs (49.5% of modified total)	$3,861.00
	Total $11,661.00	

Indirect cost for on-campus research is 49.5% of the modified total direct costs. For this project, any unit item over $5,000.00 may be considered equipment, and not subject to indirect cost charge. Thus, the total direct cost ($7,800.00) yields an indirect cost of $3,861.00. Drs. Market, Lupo, and Fox have volunteered 5%, 4%, and 3% of their time, respectively, as contributions to the oversight of the upgraded facilities.

We believe that the requested computer hardware are justified for a program of our size, and that the proposed additions would represent a major upgrade to our present networked system. The machine upgrades will allow our outdated Sun Ultra5 machines to retire; we may thus keep pace with other institutions in making the IDV available to our students for educational and research activities.

5. PROJECT MILESTONES

Equipment from these funds will be purchased and deployed immediately. We anticipate these upgrades to be complete within 1-2 months of funds receipt. More involved teaching with the IDV will ensue in the following semester.

CURRICULUM VITA

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EDUCATION:

Ph.D., Meteorology - Saint Louis University, July 1999
Dissertation Title: *Jet Streak Modification via Diabatic Heating During Periods of Intense, Cool Season Precipitation*

M.S.(R), Meteorology - Saint Louis University, May 1996
Thesis Title: *An Observational Study of Continental Occluded Cyclone Structure*

B.S., Meteorology - Millersville University of PA, May 1994

PROFESSIONAL EXPERIENCE:

Summer 2002: Instructional Design Consultant for the University Center for Atmospheric Research's Cooperative Program for Operational Meteorology, Education, and Training (UCAR/COMET). Assisted in the development of four Internet-based training modules on operational forecasting topics.

September 2005 – present: Associate Professor of Atmospheric Science
September 1999 – present: Assistant Professor of Atmospheric Science, University of Missouri-Columbia. Teach undergraduate and graduate courses in meteorology; conduct research on synoptic- and mesoscale processes.

August 1997 – July 1999: Certified weather observer (#138485) for *Midwest Weather, Inc.* Took manual and automated (ASOS) weather observations at Lambert-St. Louis Int'l (KSTL) and Spirit of St. Louis (KSUS) airports.

SELECTED PUBLICATIONS:

Anip, M. H. M., and **P. S. Market**, 2007: Dominant factors influencing precipitation efficiency in a continental mid-latitude location. *Tellus*, **59A**, 122-126. doi: 10.1111/j.1600-0870.2006.00208.x

Rochette, S.M., and **P. S. Market**, 2006: A primer on the ageostrophic wind. *Nat. Wea. Dig.*, **30**, 17-28.

Crowe, C. C., **P. S. Market**, B. P. Pettegrew, C. J. Melick, and J. Podzimek, 2006: An investigation of thundersnow and deep snow accumulations. *Geophys. Res. Lett.*, 33, L24812, doi: 10.1029/2006GL028214.

Stuart, N. A., **P. S. Market**, B. Telfeyan, G. M. Lackmann, K. Carey, H. E. Brooks, D. Nietfeld, B. C. Motta, K. Reeves, 2006: The future of humans in an increasingly automated forecast process. *Bull. Amer. Meteor. Soc.*, **87**, 1497-1502. doi: 10.1175/BAMS-87-11-1497.

Market, P. S., A. M. Oravetz, D. Gaede, E. Bookbinder, A. R. Lupo, C. J. Melick, L. L. Smith, R. S. Thomas, R. Redburn, B. P. Pettegrew, and A. E. Becker, 2006: Proximity soundings of thundersnow in the Central United States. *Journal of Geophysical Research-Atmospheres*, **111**, D19208, doi:10.1029/2006JD007061.

Market, P. S., R.W. Przybylinski, and S.M. Rochette, 2006: The role of evaporative cooling in a late-season Midwestern snow event. *Wea. Forecasting*, **21**, 364-382.

Market, P.S., 2006: The impact of writing area forecast discussions on student forecaster performance. *Wea. Forecasting*, **21**, 104-108.

Market, P. S., 2005: Cancel the Cardinals Home Opener?! Lessons in Melting and Evaporation. *Journal of College Science Teaching*, **35**(2), 22-26.

COURSES TAUGHT:

ATMS-050/-1100	Introductory Meteorology
ATMS-302/-4990	Daily Weather Analysis and Forecast Interpretation
ATMS-304/-4710	Synoptic Meteorology I
ATMS-304/-4720	Synoptic Meteorology II
ATMS-350/-7050	Fundamentals of Meteorology
ATMS-356/-7400	Micrometeorology
ATMS-370/-7350	Mesoscale Meteorology and Dynamics
ATMS-470/-8700	Advanced Synoptic Meteorology
ATMS-485/-8800	Numerical Weather Prediction
ATMS-8001/-9001	Convection and Lightning

ADVISEES:

1. Chris Melick, Ph.D., anticipated completion May 2007.
   Dissertation title: *On the Synoptic and Mesoscale Organization of Mid-latitude, Continental Convective Snow Events.*
2. Brian P. Pettegrew, Ph.D., anticipated completion May 2008.
   Dissertation title: ***Pending***.

1.	Christopher E. Halcomb,	M.S.,	December 2001.
2.	Stacy N. Allen,	M.S.,	May 2002.
3.	Angela M. Oehl,	M.S.,	May 2003.
4.	Brian P. Pettegrew,	M.S.,	July 2004.
5.	Rebecca L. Ebert,	M.S.,	July 2004.
6.	Mohd Hisham Mohd Anip,	M.S.,	May 2005.
7.	Larry Smith,	M.S.,	May 2006.
8.	Amy Becker,	M.S.,	expected May 2007
9.	Amy Schnetzler,	M.S.,	expected May 2008

GRADUATE ADVISOR: James T. Moore, Saint Louis University

Biographical Sketch

Anthony R. Lupo

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A. Vitae

1. Education

Cayuga County Community College	1984 – 1986	A.S.	Mathematics
State University of New York at Oswego	1986 – 1988	B.S.	Meteorology
Purdue University	1989 – 1991	M.S.	Atmospheric Science
Purdue University	1991 – 1995	Ph.D.	Atmospheric Science

2. Professional Experience

2003 – present	Associate Professor, University of Missouri – Columbia, Department of Atmospheric Science
1997 – 2003	Assistant Professor, University of Missouri – Columbia, Department of Soil and Atmospheric Sciences.
1995 – 1997	Postdoctoral Research Associate, State University of New York at Albany, Department of Earth and Atmospheric Sciences.

B. Professional Organizations

- American Meteorology Society
- Fellow, Royal Meteorological Society
- Missouri Academy of the Sciences
- American Geophysical Union
- National Weather Association

C. Honors and Awards

- Sigma Xi Honor Society
- Gamma Sigma Delta
- March 2002: Introductory Meteorology course was co-winner of the *Distance Learning Community of Practice* Meritorious College Course Award.
- Fulbright Research Scholar (April 2003) AY 2003 – 2004 to Russian Academy of Sciences (Member: Fulbright Scholars Alumni Association)

D. Publications (2002 – 2007)

Luo, D., and A.R. Lupo, 2007: Dynamics of eddy-driven low-frequency dipole modes. Part II: Free mode characteristics of NAO and diagnostic study. *Journal of the Atmospheric Sciences,* **64,** 3-28.

Luo, D., A.R. Lupo, and H. Wan 2007: Dynamics of eddy-driven low-frequency dipole modes. Part I: A simple model of North Atlantic Oscillations. *Journal of the Atmospheric Sciences,* **64**, 29-55.

Market, P.S., A. M. Oravetz, D. Gaede, E. Bookbinder, A.R. Lupo, C. J. Melick, L. L. Smith, R. Thomas, R. Fay, B. P. Pettegrew, and A. E. Becker, 2006: Proximity soundings of thundersnow in the central United States. *Journal Geophysical Research – Atmospheres,* **111,** D19208 – 19217.

Barriopedro, D., R. Garcia-Herrera, A.R. Lupo, and E. Hernandez, 2006: A climatology of Northern Hemipshere Blocking. *Journal of Climate,* **19,** 1042 - 1063.

Lupo, A.R., D. Albert, R. Hearst, P.S. Market, F. Adnan Akyuz, and C.L. Allmeyer, 2005: Interannual variability of snowfall events and snowfall-to-liquid water equivalents in wouthwest Missouri. *National Weather Digest,* **29, 13-24**.

Barriopedro, D., R. Garcia-Herrera, and A.R. Lupo, 2004: Metodo de Deteccion y Climatologia de Bloqueos en el Hemisferio Norte. *I Escuela de Estudios Climaticos Avanzados*, 1 – 12.

Akyuz, F.A., Chambers, M.D., and A.R. Lupo, 2004: The short and long-term variability of F2 or stronger (significant) tornadoes in the Central Plains. *Transactions of the Missouri Academy of Science,* **38,** 26-45.

Burkhardt, J.P., and A.R. Lupo, 2005: The planetary and synoptic-scale interactions in a Southeast Pacific blocking episode using PV diagnostics. *Journal of Atmospheric Sciences,* **62,** 1901 - 1916.

Akyuz, F.A., P.S. Market, P.E. Guinan, F.A. Akyuz, J.E. Lam, A. M. Oehl, and W.C. Maune, 2004: The Columbia, Missouri, Heat Island Experiment (COHIX) and the influence of a small city on the local climatology. *Transactions of the Missouri Academy of Science,* **38,** 56 - 71.

Lupo, A.R., P.S. Market, F.A. Akyuz, P.E. Guinan, J.E. Lam, A. M. Oehl, and W.C. Maune, 2003: The Columbia, Missouri, Heat Island Experiment (COHIX): The influence of a small city on local surface temperatures and the implications for local forecasts. *Electronic Journal of Operational Meteorology (www.nwas.org)*

Lupo, A.R., E.P. Kelsey, E.A. McCoy, C.E. Halcomb, E. Aldrich, S.N. Allen, A. Akyuz, S. Skellenger, D.G. Bieger, E. Wise, D. Schmidt, and M. Edwards, 2003: The presentation of temperature information in television broadcasts: What is Normal? *National Weather Digest*, **27:4,** 53 -58.

Lupo, A.R. (Contributing author only), 2003: *Report on Wind Chill Temperature and Extreme Heat Indicies: Evaluation and Improvement Projects.* An NOAA OFCM Tech. Report FCM-R-19-2003 Edited by: Mary Cairns, Cynthia Nelson. 50 pp.

Berger, C.L., A.R. Lupo, P. Browning, M. Bodner, C.C. Rayburn, M.D. Chambers, 2003: A climatology of northwest Missouri snowfall events: Long term trends and interannual variability. *Physical Geography,* **14,** 427 - 448.

Lupo, A.R., and P.S. Market, 2003: First Conference on Weather Analysis and Forecasting Issues in the Central United States. *Bulletin of the American Meteorological Society*, **84**, 1245-1247.

Ratley, C.W., A.R. Lupo and M.A. Baxter, 2002: Determining the Spring to Summer transition in the Missouri Ozarks using synoptic scale atmospheric data. *Trans. of the MissouriAcademy of Sciences,* **36***,* 69-76.

Wiedenmann, J.M., A.R. Lupo, I.I. Mokhov, and E. Tikhonova, 2002: The climatology of blocking anticyclones for the Northern and Southern Hemisphere: Block intensity as a diagnostic. *J. Climate,* **15,** 3459-3473.

Lupo, A.R., and P.S. Market, 2002: The verification of weather forecasts in central Missouri and seasonal variations in forecast accuracy. *Weather and Forecasting*, **8,** 891 - 897.

Lupo, A.R., 2002: The role of ageostrophic forcing in a height tendency equation. *Mon. Wea. Rev.,* **130***,* 115-126.

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Education

Ph.D. – Estimation of catchment flood potential using satellite data, University of Salford, UK, 1998. Advisor: Prof. Christopher G. Collier

M.Phil. – The radar reflectivity of warm stratocumulus clouds, University of Reading, 1995. Advisor: Dr. Anthony J. Illingworth.

B.Sc. - Physics, University of Manchester, UK, 1988

Post-graduate certificate in teaching and learning in higher education, University of Salford, 2001

Professional Experience

2001 - present: Assistant Professor, Department of Soil and Atmospheric Sciences, University of Missouri – Columbia. Research on radar meteorology and applications of remote sensing in surface and boundary layer processes including convective initiation, flood forecasting and extreme rainfall events.

Undergraduate classes taught: Introductory meteorology, Remote Sensing, Atmospheric Physics, Radar Meteorology, Micrometeorology, Weather Briefing.

Graduate classes taught: Atmospheric Radiation, Nowcasting, QPF.

Graduate Advisees: S.A. Lack (Ph.D.; M.S. 2004), W.T. Gilmore (M.S.), R.N. Redburn (M.S.), G.L. Limpert (M.S.), J. Miranda (M.S.), M. Dahmer (M.S.), E.A. Hatter (M.S.2004), Bun-Liong Saw (M.S.2005), D.M. Jankowski (M.S. 2006).

1999 - 2001: Postdoctoral Research Fellow, Telford Institute of Environmental Systems, University of Salford, Manchester, UK.

1996 - 1999: Post-graduate Research Assistant, Telford Institute of Environmental Systems, University of Salford, Manchester, UK.

1995: Post-graduate Research Assistant, Department of Meteorology, University of Reading, UK.

1992: Post-graduate Research Assistant, Department of Physics, University of Manchester Institute of Science and Technology, UK.

SELECTED REFEREED PUBLICATIONS

Lack, S.A., and **N.I. Fox**, 2007: Quantifying the effect of wind-drift on radar-derived surface rainfall estimations. *Atmospheric Research* (in press).

Micheas, A., **N.I. Fox**, S.A. Lack and C.K. Wikle, 2006: Cell identification and verification of QPF ensembles using shape analysis techniques. *Journal of Hydrology* (In review).

Xu, K., C.K. Wikle and **N.I. Fox**, 2005: A Kernel-based spatio-temporal dynamical model for nowcasting radar precipitation. *Journal of the American Statistical Association*, 100 (472), 1133-1144.

Fox, N.I. and C.K. Wikle, 2005: A Bayesian quantitative precipitation nowcasting scheme. *Weather and Forecasting,* 20, 264-275.

Fox, N.I. and C.K. Wikle, 2005: Providing distributed forecasts of precipitation using a Bayesian nowcast scheme. *Atmospheric Science Letters*, **6**, 59-65.

Fox, N.I. and J.W. Wilson, 2005: Very short period quantitative precipitation forecasting. *Atmospheric Science Letters,* **6**, 7-11.

Lack, S.A. and **N.I. Fox,** 2005: Errors in surface rainfall rates retrieved from radar due to wind drift. *Atmospheric Science Letters*, **6**, 66-71.

W. Hand, **N. I. Fox** & C.G. Collier, 2004: Extreme Rainfall in the UK in the 20th Century. *Meteorological Applications*, **11**, 15-31.

Fox, N.I., R. Webb, J. Bally, M.W. Sleigh, C.E. Pierce, D.M.L. Sills, P.I. Joe, J.W. Wilson and C.G. Collier, 2004: The impact of advanced nowcasting systems on severe weather warning, a case study: 3 November 2000. *Weather and Forecasting*, **19 (1),** 97-114.

Sills, D., J. Wilson, P. Joe, D. Burgess, R. Webb and **N.I. Fox**, 2004: The 3 November tornadic event during S2000: Storm evolution and the role of low-level boundaries. *Weather and Forecasting,* **19 (1),** 22-42.

C. E. Pierce, A. Seed, E. E. Ebert, **N. Fox**, M. Sleigh, C. G. Collier, N. Donaldson, J. Wilson, R. Roberts and C. Mueller, 2003: The Nowcasting of precipitation during Sydney 2000: an appraisal of the QPF algorithms. *Weather and Forecasting,* **19 (1)**, 7-21.