

Douglas M. Hultstrand

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EDUCATION

Ph.D. Candidate Earth Sciences

Colorado State University

Fort Collins, CO

M.S. Watershed Science, Hydrology

August 2006

Colorado State University

Fort Collins, CO

Thesis: "Geostatistical Methods for Estimating Snowmelt Contribution to the Annual Water Balance in an Alpine Watershed"

B.A. Physical Geography (Hydrology Certificate)

May 2003

University of Colorado

Boulder, CO

RELATED SKILLS

Physical Science Techniques

- Water Balance
- Spatial Modeling
- Data Analysis
- Storm Analysis
- Error Analysis/QC
- Proposal Writing
- PMP Analysis
- Discharge Measurements
- Water Quality Sampling
- Watershed Modeling
- Dew Point Analysis
- Eddy Covariance
- Regional L-moments
- Develop Scripts/Code
- Meteorological Measurement & Analysis
- Snow Survey and Sampling Methods
- Snow & Ground Energy Balance Computations
- Areal Reduction Factor (ARF) Calculations
- Snowmelt & Snowpack Sublimation Analysis
- Turbulent Flux Modeling (Latent and Sensible)
- Regional Climate Modeling and Data Analysis

Computer Software

- ArcView
- MS Word
- SPLUS/R
- PRMS
- GRASS GIS
- Perl
- Python
- Hysplit
- ArcGIS
- MS Excel
- IDL
- GIS Weasel
- Linux/Unix
- GrADS
- GPS Interface
- NetCDF
- ArcInfo
- MS Access
- HEC-HMS
- ERDAS
- HTML
- IPW Toporad
- WATFLOOD
- GRIB
- MATLAB
- MS Power Point
- Lecia Software
- Solar Analyst
- RAOB
- DNR Garmin
- AWK/GWAK
- UEB Snow Model

Computer Programming

- PERL
- Matlab
- R/SPLUS
- GRASS GIS
- Python
- AWK
- IDL
- Shell Scripts

Computer Operating Systems

- Linux/Unix
- Microsoft Windows
- Macintosh

WORK EXPERIENCE

Hydrometeorologist

AWA, LLC/HydroMeteorologic Solutions

Morrison, CO

2009 - Present

- Conducted in-depth analysis of extreme precipitation events for Probable Maximum Precipitation studies.
- Conducted meteorological data analysis and modeling for hydrometeorological studies.
- Analyzed 30-years of monthly mean meteorologic parameters (maximum temperature, minimum temperature, average temperature, dew point temperature, and precipitation) in conjunction with water chemistry from 68 wilderness lakes in the Colorado Rocky Mountains.
- Computed site-specific and regional L-moment statistics for frequency analysis of streamflow, snow depth, snow load, and wind speed.
- Performed quality control procedures on six years of 15-minute hydrometeorologic data and loaded into Microsoft Access database.
- Developed quality control measures for the Meteorological Assimilation Data Ingest System hourly precipitation data. PERL and R code were created for real-time precipitation quality control measures, quality control included statistical outliers, default rainfall-reflectivity relationship outliers, and spatial outliers for the US.
- Evaluated statistical and dynamical downscaling techniques to improve on large-scale forecasts of global and regional climate models for simulation of extreme rainfall.
- Created PERL and R code that integrated surface temperature measurements and balloon sonde temperature measurements; data were used to calculate hourly vertical temperature profiles and lapse rates for a period of 144-hours during several extreme precipitation events (Lewis River basin, WA and Brassua River basin, ME).
- Created PERL and R code to calculate L-moment statistics for dew point temperature frequency analysis for Arizona statewide study, southeastern United States and northeastern United States projects.
- Co-developed PERL and R code for real-time gauge-adjusted radar estimated precipitation GRASS GIS software. Real-time software utilizes quality controlled Level-II radar data, rain gauge data, climatology base maps, and numerical weather QPF, to develop and apply rainfall-reflectivity algorithms on an hourly basis to provide short range (1-24 hour) and long range (1-3 day) forecasts for use in hydrologic models.
- Co-developed PERL and R code for real-time computation of precipitation average recurrence interval software (IRainStat). IRainStat uses high resolution gauge-corrected radar-estimated rainfall and official precipitation frequency estimates published by the National Oceanic and Atmospheric Administration (NOAA); hourly rainfall data is converted into an average recurrence interval for the continental United States.
- Conducted field measurements of streamflow, water quality, snow depth, snow density, snowmelt, and snow chemistry in remote alpine regions.
- Participated in site selection, surveying, and installation of a Parshall flume in the Glacier Lakes Ecosystems Experiments Site, a US Forest Service Rocky Mountain Research Station site located in the Wyoming.
- Drafted and delivered technical reports based on hydrometeorologic quality control methods for the Rocky Mountain Research Station.
- Organized and participated in collaborative proposal writing.
- Coordinated and managed interdisciplinary research between several investigators and institutions.
- Presented research and results to scientific and general public communities.

Graduate Research Assistant

Colorado State University

Fort Collins, CO

2008 – 2011

- Computed spatial distribution of snow depth, snow density and snow water equivalent based on ground surveyed data, compared ground survey derived snow distribution (depth, density and snow water equivalent) to the National Operational Hydrologic Remote Sensing Center's SNOw Data Assimilation System (SNODAS) regional modeled snow depth, snow density, and snow water equivalent.
- Assessed the accuracy of estimated surface snowpack sublimation and coarse resolution land surface model (LSM) estimated snowpack sublimation. Quantified errors and sensitivity associated with surface based snowpack sublimation estimates at multiple high elevation regions using several methods: bulk aerodynamic profile, aerodynamic profile, and the eddy covariance. Evaluated the SNODAS modeled sublimation to surface station estimated sublimation, and scaled SNODAS data for comparison to sublimation estimated from the North American Land Data Assimilation System (NLDAS) MOSAIC model. Compared and quantified

snowpack sublimation rates temporally (hourly, daily, and seasonal) and spatially (local (surface data), 1-km² (SNODAS), ~12-km² (NLDAS)).

- Conducted research comparison between a snow energy balance model and temperature index model to quantify the spatial and temporal snowmelt contribution and stream runoff to alpine watersheds.
- Analyzed streamflow sensitivity to varying scales of temporal and spatial precipitation estimates as input to physically-based runoff model (WATFLOOD) for the November 2006 precipitation event along the Oregon coastal range.
- Computed snowpack sublimation rates at multiple high elevation regions using several methods: bulk aerodynamic profile method, aerodynamic profile method, and the eddy covariance method.
- Evaluated, designed and optimized sampling schemes for alpine snow surveys based on computed physiographic terrain parameters.
- Designed and coordinated field based snow sampling in a remote alpine watersheds (2005-2011).
- Organized, maintained, and created documentation for six years of snow depth and snow density observations.
- Applied snowpack energy balance to simulate and forecast mountain snowpack processes.
- Created lecture notes, field notes and instructed WR 575 - Snow Hydrology Field Methods.
- Contributed as lead author and co-author for journal publications.
- Developed Python/GIS code to derive terrain based parameters of wind shelter and wind drift in alpine regions.
- Presented research and results to scientific and general public communities.

Senior Hydrometeorologist

Metstat, Inc.

Windsor, CO

2006 - 2008

- Managed, manipulated, created, interpreted and documented large meteorological datasets with differing formats through the use of Linux, GRASS GIS, and R programming scripts.
- Conducted in-depth analysis of extreme precipitation events for Probable Maximum Precipitation studies.
- Conducted meteorological data analysis and modeling for hydrometeorological studies.
- Created GIS/cartographic precipitation frequency maps for the National Weather Service Hydrologic Design Studies Center NOAA Atlas 14 Precipitation Frequency Data Server: Ohio River Basin and Semi-Arid Southwest.
- Created detailed gridded precipitation analysis, real-time gauge-adjusted radar rainfall products, weather frequency analysis, weather event reconstructions, and spatial interpolation of meteorological and climatological variables.
- Developed weather frequency statistics and re-constructed weather events to support a wide variety of applications.
- Co-developed methodology and code (PERL, R, GRASS GIS) to determine temporal distribution of Probable Maximum Precipitation events as a function of area size.
- Developed accurate, innovative and detailed meteorological and hydrometeorological information to help engineers, hydrologists and hydrometeorologists optimize the design and operation of infrastructure.
- Operated the Storm Precipitation System in Real-Time (SPASRT) for a number of areas across the United States as well as analyze historical rainfall events using the legacy Storm Precipitation Analysis System (SPAS).
- Researched precipitation areal reduction factor (ARF) methodology, and developed code (PERL, GRASS GIS, R) to derive storm-based ARFs to aid the National Weather Service Hydrologic Design Studies Center project to update ARFs in the United States.
- Performed hydrologic modeling of streamflow using HEC-HMS with high spatial and temporal precipitation estimates.
- Conducted vertical temperature and wind speed analysis for Mt. Baker region, integrated surface measurements, MM5 climate model estimates, and balloon sonde data.
- Improved spatial and temporal precipitation estimates with spatial interpolation techniques that incorporated precipitation climatology, station data, and the weather research and forecasting (WRF) model.
- Incorporated surface station data, historic station data, satellite data, and ground-based snowpack estimates to quantify the spatial distribution of snow water equivalence and snowload in central Idaho.
- Computed site-specific and regional L-moment statistics for frequency analysis of streamflow, snow depth, snow load, and wind speed.
- Presented research and results to scientific and general public communities.

Graduate Teaching Assistant*Colorado State University*

Fort Collins, CO

2004 – 2006

- Taught and advised students in Watershed Problem Analysis (WR440) and Snow Hydrology (WR474/574). Watershed Problem Analysis entailed teaching students to conduct and write up a hydrologic analyses for a surface coal mine in accordance with the regulations of the Surface Mining Control and Reclamation Act. Snow Hydrology entailed teaching students to conduct and write up a annual hydrologic analyses to determine the significance snow and snowmelt have on local surface climatology and a local water balance.
- Instructed students on procedures to compute and analyze streamflow, to model snowmelt, and to perform synthetic unit hydrograph analysis.
- Instructed students on methods to collect water quality samples and stream discharge samples.
- Instructed students on procedures to collect, analyze, and disseminate water resources data.
- Instructed students on HEC-HMS modeling procedures that accounted for streamflow, reservoir storage, snowmelt, and channel routing.
- Presented bi-weekly lectures to students and advised students with questions.
- Planned, designed and coordinated weekly field based snow sampling in remote alpine watersheds.

Graduate Research Assistant*Colorado State University*

Fort Collins, CO

2005 – 2006

- Performed weekly meteorologic and hydrologic sampling at the Glacier Lakes Ecosystems Experiments Site, a US Forest Service Rocky Mountain Research Station site located in the Wyoming Snowy Range Mountains.
- Performed meteorological maintenance on the AmeriFlux station "GLEES" and the National Atmospheric Deposition Program (NADP) station "WY00".
- Analyzed sixteen years of meteorologic and hydrologic data for the USFS Rocky Mountain Research Station.
- Surveyed permanent snowfield (West Glacier Lake Watershed, WY) using Trimble GPS and Total Station to model the topography and to quantify the amount of water stored within the permanent snowfield.
- Modeled the spatial and temporal snowmelt runoff in West Glacier lake watershed.
- Gathered satellite derived snow covered area data for computation of snow covered area depletion curve used in snowmelt modeling.
- Incorporated surface station data, satellite data, modeled data, terrain derived physiographic data, and ground-based survey data to determine the spatial distribution of snow depth, snow water equivalence, and snow cover area.
- Analyzed hourly streamflow data for stochastic modeling of short range streamflow forecasts.
- Analyzed aircraft Lidar snow depth data and compared to ground based snow survey data applied to geostatistical methods to estimate snow depth distribution data.
- Conducted weekly water quality sampling and stream discharge sampling in two alpine watersheds.
- Conducted stream discharge measurements and updated stage-discharge relationships for three remote alpine streams.
- Maintained remote meteorological stations, downloaded data, uploaded new data logger programs, and repaired/replaced sensors.
- Installed, constructed, disassembled, and maintained remote stream gauges.
- Collected discharge measurements on frozen lakes and streams.
- Conducted water quality sampling and discharge sampling in remote alpine regions.
- Organized, maintained, and created documentation of historical meteorologic and hydrologic measurement station records for the Glacier Lakes Ecosystems Experiments Sites.
- Used hand tools to maintain, update, and build remote meteorologic and hydrologic monitoring stations.
- Presented research and results to scientific and general public communities.

Hydrologic Technician*USGS Alpine Hydrology Research Group (AHRG)*

Lakewood, CO

2002 – 2005

- Performed quality control methods and data analysis on fifteen years of meteorologic climate data and loaded into Microsoft Access database.
- Conducted weekly samples of snow depth, snow density, and snow chemistry for remote alpine regions in Rocky Mountain National Park.

- Measured stream discharge using several methods: wading rods measurements, bridge measurements, boat measurements, ice measurements, Parshall Flume measurements, volumetric measurements, and indirect measurements (weir, flumes, and gated structures).
- Conducted water quality sampling and discharge sampling in remote alpine regions.
- Analyzed the 2001-2005 Rocky Mountain snow chemistry data.
- Maintained remote hydrologic stations, downloaded data, uploaded new data logger programs, repaired/replaced sensors.
- Surveyed Andrew's Glacier in Rocky Mountain National Park, Colorado using Trimble GPS and Total Station to model surface topography for comparison to survey performed ten years earlier.
- Conducted stream discharge measurements and updated stage-discharge relationships for remote alpine streams. Updated stage-discharge rating curve coefficients to improve streamflow estimates.
- Conducted lake core samples and lake water quality samples from inflatable boat in alpine regions.
- Filed water quality and streamflow data on to the National Water Information System (NWIS) database.
- Constructed, disassembled, and maintained remote stream gauges.
- Provided inspection reports on hydrologic and meteorologic instrumentation operation and performance.
- Collected discharge measurements on frozen lakes and streams.
- Collected stream discharge measurements with wading rods measurements, bridge measurements, boat measurements, ice measurements, Parshall Flume measurements, volumetric measurements, indirect measurements (weir, flumes, and gated structures).
- Organized, maintained, and created documentation of historical meteorologic and hydrologic measurement records in Loch Vale watershed, Colorado.
- Used hand tools to maintain, update, and build remote meteorologic and hydrologic monitoring stations.

Undergraduate Research Assistant

*Institute of Arctic and Alpine Research (INSTAAR)
University of Colorado*

Boulder, CO
2002 – 2003

- Collected and analyzed alpine hydrologic and meteorologic data on Niwot Ridge, CO.
- Analyzed weather balloon data collected at Summit, Greenland, created IDL code to filter and plot 3-dimensional representation of balloon sonde data.
- Computed diurnal transfer rate of chemicals from the atmosphere to the snowpack and snowpack to the atmosphere and its dependence on different atmospheric conditions.
- Conducted literature review of air quality and ozone interactions with seasonal snowpacks.
- Conducted weekly snow sampling of depth, density, and water quality at Niwot Ridge LTER site for Dr. Mark Williams.
- Presented research and results to scientific and general public communities.

AWARDS & HONORS

- Executive Program Committee Member (data analysis and modeling) National Hydrologic Warning Council.
- Colorado Water Resources Research Institute (CWRI) Grant, 2008-2009
- Graduate Research Funds, 2005
- USGS STAR Award, 2003, 2004, and 2005
- Albert W. Smith Geography Scholarship, 2002
- Dean's List, 1999, 2000, 2001, and 2002
- Golden Key International Honour Society, 2002 and 2011
- The National Society of Collegiate Scholars, 2001
- Phi Beta Kappa, 2001

PROFESSIONAL AFFILIATION

- American Geophysical Union (AGU)
- American Meteorological Society (AMS)
- Western Snow Conference (WSC)
- Association of State Dam Safety Officials (ASDSO)
- National Hydrologic Warning Council (NHWC)
- American Water Resources Association (AWRA)

PUBLICATIONS & CONFERENCE PROCEEDINGS

- **Hultstrand, D.M.**, J.D. Stednick, and S.R. Fassnacht, 2011. Geostatistical Methods for Estimating Snowmelt Contribution to the annual Water Balance of an Alpine Watershed, Wyoming, USA. *Hydrological Processes* (submitted).
- Fassnacht, S.R., R. Bales, K. Dressler, and **D.M. Hultstrand**, 2011. The relationship between physiographic variables and snow water equivalent from snow telemetry (SNOTEL) sites in the Colorado River basin, USA. *Water Resources Research* (submitted).
- Fassnacht, S.R., R. Bales, K. Dressler, and **D.M. Hultstrand**, 2011. Inconsistency in the Large-scale Physiographic Drivers for Snow Accumulation across the Colorado River Basin. *Proceedings of the Eastern Snow Conference*, Ontario, Canada, June 14-16, 2011 (submitted).
- Parzybok, T.W., B. Clarke, **D.M. Hultstrand**, E.M. Tomlinson, and W.D. Kappel, 2011. The Storm Precipitation Analysis System (SPAS): An Innovative Approach to Real-time Precipitation Estimation Across All Terrains using a Combination of Calibrated Radar Rates, Gauge Adjusted Radar and Basemap Techniques. *Journal of Hydrologic Engineering* (submitted).
- Parzybok, T.W., B. Clarke, and **D.M. Hultstrand**, 2011. Average Recurrence Interval of Extreme Rainfall in Real-Time. *Electronic Journal EarthZine: Extreme Weather*.
- **Hultstrand, D.M.**, T.W. Parzybok, E.M. Tomlinson and W.B. Kappel, 2009. Advanced Spatial and Temporal Rainfall Analyses for Use in Watershed Models. In *U.S. Geological Survey Scientific Investigations Report: Proceedings of the Third Interagency Conference on Research in the Watersheds*, Estes Park, CO, Sept. 2008.
- Tomlinson, E.M., W.B. Kappel, P.J. Diederich, T.W. Parzybok, and **D.M. Hultstrand**, 2008. Nebraska Statewide Probable Maximum Precipitation (PMP) Study.
- Tomlinson, E.M., W.B. Kappel, T.W. Parzybok, **D.M. Hultstrand**, and G. Muhlestein, 2008. Site-Specific Probable Maximum Precipitation (PMP) Study for the Magma Drainage Basin, AZ.
- Tomlinson, E.M., W.B. Kappel, T.W. Parzybok, **D.M. Hultstrand**, and G. Muhlestein, 2008. Site-Specific Probable Maximum Precipitation (PMP) Study for Blenheim-Gilboa Drainage Basin, NY.
- Fassnacht, S.R., **D.M. Hultstrand**, and R.C. Bales, 2007. Physiographic Variables to Describe Basin Scale Snow Water Equivalent. *EOS Trans.*, AGU, Fall Meet. Suppl., 88(52): C21B-0456.
- Ingersoll, G.P., A.M. Mast, L. Nanus, H. Handran, D.J. Manthorne, and **D.M. Hultstrand**, 2007, Rocky Mountain snowpack chemistry at selected sites, 2004: *U.S. Geological Survey Open-File Report 2007-1045*, 15 p.
- **Hultstrand, D.M.**, S.R. Fassnacht, and J.D. Stednick, 2006. Geostatistical Methods for Estimating Snowmelt Contribution to an Alpine Water Balance. *Proceedings of the Western Snow Conference*, Las Cruces, NM, April 17-20 2006.
- **Hultstrand, D.M.**, 2006. *Geostatistical Methods for Estimating Snowmelt Contribution to the Seasonal Water Balance in an Alpine Watershed*. Master of Science Thesis, Watershed Science Program, Colorado State University, 130 pp.
- Korfmacher, J.L. and **D.M. Hultstrand**, 2006. Glacier Lakes Ecosystem Experiments Site (GLEES) NADP (WY00) hourly meteorological tower data: 1991-2005. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Korfmacher, J.L. and **D.M. Hultstrand**, 2006. Glacier Lakes Ecosystem Experiments Site (GLEES) hourly meteorological tower data: 1989-2005. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Ingersoll, G.P., M.A. Mast, L. Nanus, D.J. Manthorne, H.H. Handran, **D.M. Hultstrand**, and J. Winterringer, 2005. Rocky Mountain Snowpack Chemistry at Selected Sites, 2003: *U.S. Geological Survey Open-File Report 2005-1332*, 17 p.

PRESENTATIONS

- 2011, Speaker, Use of High Resolution Gauge Adjusted Precipitation in the Verification of Numerical Quantitative Precipitation Forecasts for West Coast Atmospheric River Events. National Hydrologic Warning Council, San Diego, California.

- 2010, Presentation, Average Recurrence Interval of Event Precipitation in Real-Time. ASDSO Conference, Seattle, Washington.
- 2010, Presentation, Inconsistency in the Large-Scale Physiographic Drivers for Snow Accumulation across the Colorado River Basin. Eastern Snow Conference, Ontario, Canada.
- 2010, Speaker, Estimating Hydrologic Uncertainties in Water Balance Studies. Seminar, Fort Collins, Colorado.
- 2009, Presentation, Snow Depth Measurement Variability Across Two Study Domains. American Geophysical Union, San Francisco, California.
- 2009, Presentation, Improving Hydrologic Calibration and Validation Analyses with Radar-Estimated Precipitation from the Storm Precipitation Analysis System. Northeast Regional ASDSO, State College, Pennsylvania.
- 2009, Speaker, Incorporating Advanced Spatial and Temporal Rainfall Data into Hydrologic Models. Waterpower XVI, Spokane, Washington.
- 2009, Presentation, Improving Hydrologic Analysis and Applications through the Use of Near Real-Time Storm Precipitation Analysis System (SPAS). Waterpower XVI, Spokane, Washington.
- 2009, Presentation, How six Extreme Pacific Northwest Storms Compare to Historical Storms in HMR 57. Western Regional ASDSO, Couer d'Alene, Idaho.
- 2009, Presentation, Arizona Statewide Probable Maximum Precipitation (PMP), Improving HMR 49. Western Regional ASDSO, Couer d'Alene, Idaho.
- 2009, Speaker, Improving Hydrologic Analysis and Applications through the Use of Quality Controlled Radar Data and the Storm Precipitation Analysis System. National Hydrologic Warning Council, Vail, Colorado.
- 2009, Speaker, Accuracy of Spatial Precipitation Estimates for Hydrologic Modeling. 29th Annual American Geophysical Union (AGU) Hydrology Days, Fort Collins, Colorado.
- 2008, Presentation, High-Resolution Storm Rainfall Analysis for Use in Hydrologic Modeling: Storm Precipitation Analysis System (SPAS) and NEXRAD Weather Radar, Hydrovision, Sacramento, CA.
- 2008, Poster, Advanced Spatial and Temporal Rainfall Analysis for Use in Watershed Models, Third Interagency Conference on Research in the Watersheds, Estes Park, CO.
- 2008, Speaker, Estimating Errors Associated with Calculated Sublimation from Seasonally Snow-Covered Environments, Colorado Water Resources Research Institute, Fort Collins, CO.
- 2007, Presentation, Detailed Storm Rainfall Analysis for Hurricane Ivan Flooding in Georgia Using the Storm Precipitation Analysis System (SPAS) and NEXRAD Weather Radar, Hydropower, Knoxville, TN.
- 2006, Speaker, Glacier Lakes Ecosystems Experiments Site (GLEES), Rocky Mountain Research Station (RMRS) Project Review.
- 2006, Speaker, Geostatistical Methods for Estimating Snowmelt Contribution to the Annual Water Balance in an Alpine Watershed. 26th Annual American Geophysical Union Hydrology Days, Fort Collins, Colorado.
- 2005, Speaker, 60th Annual Meeting of the Rocky Mountain Hydrologic Research Center, Fort Collins, Colorado.