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PROFESSIONAL SUMMARY

Scientific Research Experience

- Recent research foci:
 - ~ developing and operationalizing the Evaporative Demand Drought Index – a tool for early warning and monitoring;
 - ~ developing and operationalizing services of continental- and global-scale, real-time forecasts and reanalyses of hydrologic variables;
 - ~ examining the effects of climate change and variability on the hydrosphere, specifically moisture dynamics at the land surface-atmosphere interface;
 - ~ partitioning dynamics of secular hydrologic trends and variability, particularly in evaporative drivers;
 - ~ quantifying and describing the spatial distribution of large-scale, natural water supply;
 - ~ reformulating and improving modeling and metering of drought.
- Core research skills:
 - ~ spatial and time-series analyses;
 - ~ hydrologic model creation, calibration, and assessment;
 - ~ GIS and programming (UNIX/Linux scripting, FORTRAN, IDL, Python);
 - ~ management of large datasets;
 - ~ fieldwork, including flow gauging and tracing, water quality and soil sampling, surveying, and hydrometeorologic experimentation from design and field-data capture to troubleshooting;
 - ~ outreach with stakeholders and scientists from other fields (climatologists, ecologists, economists);
 - ~ communicating with diverse audiences on various topics through peer-reviewed scientific literature, conference papers, and direct instruction.

Service and Teaching Experience

- Science community service:
 - ~ American Meteorological Society (AMS) Committee on Hydrology member, 2017-2020
 - ~ session chair: new evapotranspiration- and drought-related sessions at 2014-2016 American Geophysical Union (AGU) Fall Meetings;
 - ~ session chair: evapotranspiration sessions at 2012-2018 AMS Annual Meetings;
 - ~ session chair: drought sessions at 2016-2018 AMS Annual Meetings;
 - ~ conference co-chair: 32nd (2018) and 33rd (2019) Hydrology Conferences at AMS Annual Meetings;
 - ~ lead author: chapter on evapotranspiration in American Society of Civil Engineers Environmental Water Resources Institute manual, *Statistical Distributions in Hydrology*;
 - ~ lead author: chapter on evapotranspiration and evaporative demand in *Handbook of Applied Hydrology*, McGraw-Hill;
 - ~ lead author: chapter on evapotranspiration, evaporative demand, drought, and climate change in 2nd edition of *Drought and Water Crises: Science, Technology and Management Issues*, CRC Press;
 - ~ convener: year-long, weekly seminar series for in-house, national, and international speakers at Research School of Biological Sciences, Australian National University;
 - ~ proposal review panel member: NASA Modeling, Applications, and Predictions program;
 - ~ peer reviewer: Agricultural and Forest Meteorology; Bulletin of the American Meteorological Society; Climate; Climatic Change; Earth Interactions; Environmental Research Letters; Geophysical Research Letters; Hydrologic and Earth System Sciences (HESS); Hydrological Processes; Hydrological Sciences Journal; Hydrology Research; International Journal of Climatology; IPCC

Fourth Assessment Report; Journal of Applied Meteorology; Journal of Geophysical Research-Atmospheres; Journal of Great Lakes Research; Journal of Hydrologic Engineering; Journal of Hydrology; Journal of Hydrometeorology; Journal of Irrigation and Drainage Engineering; Journal of Water Resources Management; PLOS ONE; Theoretical and Applied Climatology; Water; Water Resources Research.

- Teaching experience:
 - ~ graduate teaching assistant: Colorado State University, *Engineering Mechanics-Statics*, a 200-level three-credit course in core engineering curriculum;
 - ~ instructor: COMET MetEd, *Evaporative Demand*, in Advanced Hydrologic Sciences Virtual Course;
 - ~ doctoral committee member for Daniel McEvoy, University of Nevada-Reno.

EDUCATION

- Doctor of Philosophy** 2004
Hydrologic Science and Engineering *Colorado State University*
Dissertation: *Regional evapotranspiration and pan evaporation: Complementary interactions and long-term trends across the conterminous United States.*
- Master of Science** 2000
Hydrologic Science and Engineering *Colorado State University*
Thesis: *Evaluating and enhancing two implementations of the complementary relationship in regional evapotranspiration.*
- Bachelor of Engineering (Honors)** 1989
Civil Engineering *University of Leeds, UK*

PRIZES, AWARDS, AND GRANTS

- ~ American Society of Agricultural and Biological Engineers (ASABE) Superior Paper Award for paper: “The variability of ASCE Standardized Reference Evapotranspiration: a rigorous, CONUS-wide decomposition and attribution,” 2017
- ~ National Integrated Drought Information System (NIDIS) grant (\$36K): “Development of a Nevada Drought Early Warning System and NIDIS Application Tools,” 2016-2018.
- ~ National Oceanic and Atmospheric Administration (NOAA) Climate Program Office (CPO) Sectoral Applications Research Program (SARP) grant (\$38K): “Developing a wildfire component for the NIDIS California Drought Early Warning System,” 2016-2018.
- ~ NOAA Office of Oceanic and Atmospheric Research (OAR) Joint Technology Transfer Initiative (JTII) grant (\$891K): “Operationalizing an Evaporative Demand Drought Index (EDDI) service for drought monitoring and early warning,” 2016-2019.
- ~ Gary Comer Abrupt Climate Change Fellowship, 2005-2008.
- ~ National Science Foundation (NSF) Computer Science, Engineering, and Mathematics Scholarship, 2002.
- ~ H. W. Shen Water Resources Graduate Award, Colorado State University, 2001.
- ~ American Geophysical Union (AGU) Hydrology Days Best M.S. Student Paper Award for presentation: “The complementary relationship in regional evapotranspiration: The CRAE Model and the Advection-aridity approach,” 1999.

AFFILIATIONS AND PROFESSIONAL MEMBERSHIPS

- ~ Faculty Affiliate: Colorado State University, Fort Collins, CO, 2015-2018.
- ~ Member: American Geophysical Union.
- ~ Member: American Meteorological Society.
- ~ Member: International Association of Hydrological Sciences.

RELEVANT WORK EXPERIENCE

Research Scientist III

Oct 2012 - Present

Physical Sciences Division, NOAA-Earth System Research Laboratory (NOAA-ESRL) Boulder, CO

Developing a national reference evapotranspiration (ET_0) service for NOAA and NIDIS stakeholders and the National Water Center and a global ET_0 service for the Famine Early Warning Systems Network (FEWS NET). Contracted to NOAA through first, the University Corporation for Atmospheric Research (UCAR) Visiting Scientist Program and, second, the Cooperative Institute for Research in Environmental Sciences (CIRES).

- ~ Developing the first ET_0 services (physically based, daily, accurate, long-term) for (i) NOAA (CONUS-wide) and (ii) FEWS NET (global), including automation of production, verification against observations, bias-correction, and data assimilation;
- ~ Developing a new drought ET_0 -based index for monitoring and early warning—the Evaporative Demand Drought index (EDDI)—and transitioning it to operations and general acceptance by drought-monitoring and scientific communities;
- ~ Acting as scientific advisor and coordinator to an NWS-wide team developing the nation's first real-time forecasts of ET_0 (FRET), developing ET_0 algorithms and climatologies to add value to forecasts, presenting new FRET product at national scientific and professional meetings;
- ~ Outreach to stakeholders, including within NOAA, other US government agencies, academics (including ecologists and economists), intergovernmental groups such as the Western Governors Association, state climatologists (UT, CO, and CA), students in training courses (COMET);
- ~ Collaborating with various federal and state agencies (e.g., with USGS towards an ET input to the National Water Census, and the production of official state ET_0 climatologies), with university researchers (e.g., with UCLA on developing remotely sensed E_0), and with other research institutions (e.g., with the Desert Research Institute on large-scale ET estimation);
- ~ Educating colleagues in NWS and NOAA on principles pertaining to ET and E_0 .
- ~ Hiring a post-doc: reviewing application material and conducting interviews;
- ~ Presenting background scientific and ongoing project material to colleagues at the NWS OHD, NOAA's Climate Prediction Center, the CBRFC, Service Hydrologists at other RFCs, and other WFOs, at various inter-agency, regional and national meetings;
- ~ Responsible for developing funding streams through strategic grant-seeking, from NOAA Office of Hydrologic Development (OHD), NIDIS, and Famine Early Warning Systems Network (FEWSNET).

Visiting Scientist

Oct 2009 - Oct 2012

National Weather Service (NWS), Colorado Basin River Forecast Center (CBRFC) Salt Lake City, UT

Improving the treatment of evapotranspiration (ET) in NWS operations, by (i) improving water-supply forecast skill of CBRFC's river forecast model by incorporating a physically based, dynamic driver of evaporative demand (E_0), and (ii) instituting a forecast of reference crop evapotranspiration (FRET) throughout the NWS Western Region (WR). Contracted to NWS-CBRFC through Wyle Information Systems Group and UCAR Visiting Scientist Program.

- ~ Increased CBRFC's streamflow forecast skill by optimizing the evaporation drivers in the Sacramento Soil Moisture Accounting streamflow simulation model;
- ~ Acted as scientific advisor and coordinator to an NWS WR team developing the nation's first real-time forecasts of ET_0 (FRET), developing E_0 algorithms and climatologies to add value to forecasts, presenting new FRET product at national scientific and professional meetings;
- ~ Developed and hosting real-time and forecast datastreams of E_0 for use by drought-monitoring community, and developing a stand-alone E_0 -based drought metric for use in the input suite for the United States Drought Monitor;
- ~ Liaising with WR headquarters, other RFCs and Weather Forecast Offices (WFOs) to align various disparate efforts on research into ET , and towards distribution and verification of FRET;
- ~ Collaborating with various federal and state agencies (e.g., with USGS towards an ET input to the National Water Census, and the production of official state ET_0 climatologies), with university

- researchers (e.g., with UCLA on developing remotely sensed E_0), and with other research institutions (e.g., with the Desert Research Institute on large-scale ET estimation);
- ~ Educating colleagues in NWS and NOAA on principles pertaining to ET and E_0 .
 - ~ Presenting background scientific and ongoing project material to colleagues at the NWS OHD, NOAA's Climate Prediction Center, the CBRFC, Service Hydrologists at other RFCs, and other WFOs, at various inter-agency, regional and national meetings;
 - ~ Leading and collaborating on funding proposals from internal and external (NOAA, NASA, USGS) sources.

Post-Doctoral Fellow

Aug 2005 - Jan 2009

Australian National University, Research School of Biological Sciences (RSBS)

Canberra, Australia

Examined evaporative dynamics at spatial scales from point to continental, and temporal scales from instantaneous to multi-decadal. Explored E_0 as a driver of drought.

- ~ Designed and conducted a field experiment on fine-scale physics of evaporation pans. Collected, quality-controlled, stored, and analyzed micro-meteorological and thermodynamic data.
- ~ Analyzed trends in evaporative demand and drought exposure and under past and predicted climate change. Examined the effects of non-traditional different evaporative drivers in drought modeling.
- ~ Collated NetCDF output from multiple GCM scenarios and generated intermediate NetCDF output from offline modeling toward the first analysis of evaporative demand under modeled climate change.
- ~ Wrote or co-authored six peer-reviewed journal articles, reported research results in seven oral papers and two posters at national and international conferences.
- ~ Organized and conducted week-long familiarization programs to attract top undergraduates from Australia and New Zealand to graduate research at RSBS.

Water Resources Engineer and Data Analyst

Jun 2003 - Jul 2005

Riverside Technology, inc. and Paluster Environmental Services

Fort Collins, CO

While in graduate school, consulted to National Weather Service (NWS) for flood-forecasting and the Rio Grande Water Conservancy District on an assessment of ET from groundwater in the San Luis Valley, CO.

- ~ Evaluated, analyzed, and managed raw micro-meteorological data. Gathered new literature online.
- ~ Calibrated NWS's river forecasting suite of models (SNOW-17 and Sacramento Soil Moisture Accounting models) for basins in the New England and Southeast River Forecasting Centers.
- ~ Prepared and reviewed academic papers and project reports on procedures and results.

Post-Doctoral Research Fellow and Graduate Research Assistant

May 1996 - May 2005

Colorado State University (CSU), Civil Engineering Department

Fort Collins, CO

Conducted research into a new paradigm in estimating actual ET while first a Graduate Research Assistant, then a Post-Doctoral Research Fellow. Funded by the US Forest Service Rocky Mountain Research Station.

- ~ Evaluated two models of the complementary relationship in regional ET across CONUS and refined one model for use on a regional and seasonal basis.
- ~ Implemented ARC/INFO and ArcView GIS packages to create a suite of user-friendly FORTRAN-nested Arc Macro Language (AML) programs to run ET model over CONUS.
- ~ Using station-based and remotely sensed datasets, created the first long-term, monthly, continental-scale, high resolution, accurate time-series of ET and intermediate variables.
- ~ Conducted secular trend analyses on 42-year monthly time-series of ET and its components.
- ~ Reported research results in peer-reviewed journal articles and at national and regional conferences.