Christopher J. Crawford, Ph.D.

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Earth System Science Interdisciplinary Center
University of Maryland
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Biographical Information

Current Positions

Landsat Science Team Scientist, Arctic Slope Research Corporation (ASRC) Federal InuTeq Contractor / U.S. Geological Survey Earth Resources Observation and Science (EROS) Center — March 2017

Postdoctoral Research Associate, Earth System Science Interdisciplinary Center (ESSIC) University of Maryland / Cryospheric Sciences Laboratory, NASA/GSFC — 2015 – present

NASA SnowEx Organizing Team Member — 2015 – present

Previous Positions

2013 – 2015	**NASA Postdoctoral Program Fellow**, Oak Ridge Associated Universities (ORAU), Cryospheric Sciences Laboratory, NASA/GSFC
2010 – 2013	**NASA Earth and Space Science Fellow**, Department of Geography, University of Minnesota
Fall 2012	**Graduate Teaching Assistant**, Department of Geography, University of Minnesota
Fall 2011	**Visiting NASA Earth and Space Science Fellow**, Cryospheric Sciences Laboratory, NASA/GSFC
Fall 2010	**Graduate Teaching Assistant**, Department of Geography, University of Minnesota
2008 – 2010	**Graduate Research Assistant**, Department of Geography, University of Minnesota
2008	**Lecturer**, Department of Geography and Earth Sciences, University of North Carolina-Charlotte
2007 – 2008	**Remote Sensing/GIS Research Assistant and Lab Coordinator**, Center for Applied Geographic Information Science Laboratory (CAGIS), Department of Geography and Earth Sciences, University of North Carolina-Charlotte
2007	**Adjunct Instructor**, Department of Education, Kings College
2006 – 2007	**Graduate Teaching Assistant**, Department of Geography, Virginia Polytechnic Institute and State University (Virginia Tech)

Education

2013 (June)	Ph.D. (Geography), Department of Geography, University of Minnesota

2007 (May)	M.S. (Geography), Department of Geography, Virginia Polytechnic Institute and State University (Virginia Tech)
2004 (May)	B.S. Cum Laude (Forest Resources), Department of Forestry, Fisheries, and Wildlife, University of Tennessee-Knoxville

Awards and Honors

2014 – 2015	NASA Postdoctoral Program Fellow, ORAU / NASA
2013 – 2014	NASA Postdoctoral Program Fellow, ORAU / NASA
2012 – 2013	NASA Earth and Space Science Fellow, University of Minnesota / NASA
2012	Ralph Hall Brown Prize-Best Graduate Student Publication, Department of Geography, University of Minnesota
2011 – 2012	NASA Earth and Space Science Fellow, University of Minnesota / NASA
2010 – 2011	NASA Earth and Space Science Fellow, University of Minnesota / NASA
2010	Chimborazo Student Research Award, Association of American Geographers (AAG) Mountain Geography Specialty Group
2010	Student Research Award, AAG Paleoenvironmental Change Specialty Group
2010	Student Travel Award-International Geographic Information Fund (IGIF), AAG
2009	Adams-Abler Summer Field Fellowship, Department of Geography, University of Minnesota

Scholarship

Refereed Publications (in print)

[10] Crawford, C.J., P.K. Campbell, E.M. Middleton, M.G. Hom, K.F. Huemmerich, and D.R. Landis (to be published). Retrieval of Lake Superior ice surfaces using EO-1 Hyperion, Landsat ETM+, and Landsat OLI. *Proceedings from the 23rd IAHR International Symposium on Ice*.

[9] Crawford, C.J., D. Griffin, and K.F. Kipfmueller. (2015). Capturing season specific precipitation signals in the northern Rocky Mountains, USA using earlywood and latewood tree rings. *Journal of Geophysical Research-Biogeosciences* 120.doi:10.1002/2014JG002740.

[8] Hall, D.K., C.J. Crawford, N.E. DiGirolamo, G.A. Riggs, and J.L. Foster. (2015). Detection of earlier snowmelt in the Wind River Range, Wyoming, using Landsat imagery, 1972-2013. *Remote Sensing of Environment* 162:45-54.doi:10.1016/j.rse.2015.01.032.

[7] Crawford, C.J. (2015). MODIS Terra Collection 6 fractional snow cover validation in mountainous terrain during spring snowmelt using Landsat TM and ETM+. *Hydrological Processes* 29:128-138.doi:10.1002/hyp.10134.

[6] Klink, K., J.J. Wiersma, C.J. Crawford, D.D. Stuthman (2014). Impacts of temperature and precipitation variability in the Northern Plains of the United States and Canada on the productivity of spring barely and oat. *International Journal of Climatology* 34:2805-2818. doi:10.1002/joc.3877.

[5] Crawford, C.J. (2013). Evidence for spring mountain snowpack retreat from a Landsat-derived snow cover climate data record. *The Cryosphere Discussion* 7:2089-2117.doi:10.5194/tcd-7-2089-2013.

[4] Crawford, C.J., S.M. Manson, M.E. Bauer, and D.K. Hall (2013). Multitemporal snow cover mapping in mountainous terrain for Landsat climate data record development. *Remote Sensing of Environment* 135:224-235.doi:10.1016/j.rse.2013.04.004.

[3] Crawford, C.J. (2012). Do high-elevation northern red oak tree-rings share a common climate-driven growth signal? *Arctic, Antarctic, and Alpine Research* 44:26-35.doi:10.1657/1938-4246-44.1.26.

[2] Copenheaver, C.A., C.J. Crawford, and T.M. Ferrer (2011). Age-dependent climate responses identified in the growth of white oak (*Quercus alba*). *Trees, Structure, and Function* doi: 10.1007/s00468-011-0541-2.

[1] Crawford, C.J. and L.M. Kennedy (2009). Spatial and temporal patterns of tree encroachment into a Southern Appalachian grass/heath bald. *Natural Areas Journal* 29(4):500-508.

Refereed Publications (in review or under revision)

Crawford. C.J., M.G. Hom, J.W. Cooper, K.M. Brunt, T.A. Neumann, D.J. Harding, P.W. Dabney, J.J. Butler, C.S. Cleckner, and T. Markus (under revision). Calibration of spectroscopic snow, ice and liquid water measurements for the airborne SIMPL/AVIRIS-NG 2015 Greenland campaign. *Resubmission to Applied Optics*

Other Publications

Klink, K., C.J. Crawford, J.A. Jochum, D.D. Stuthman (2011). Climate variability and the productivity of barley and oats in Minnesota. *CURA Reporter* 41(1):12-18.

Conference/Symposium Presentations

Crawford, C.J. (2006). Climatic variability and red spruce growth (*Picea rubens* Sarg.) in the Southern Appalachians. *Laboratory of Tree Ring Research (LTRR) Summer School, University of Arizona*, Tucson, Arizona. [ORAL]

Crawford, C.J., and L.M. Kennedy (2006). A 250-year tree-ring record of northern red oak (*Quercus rubra*) establishment and recruitment in a southern Appalachian grass/heath bald. *Southeastern Division of the Association of American Geographers*, Morgantown, West Virginia. [ORAL]

Crawford, C.J., and L.M. Kennedy (2007). A tree-ring record of climate, disturbance, and tree encroachment in a southern Appalachian grass/heath bald. *Association of American Geographers*, San Francisco, California. [ORAL]

Shoemaker, D.A., R.K. Meentemeyer, and C.J. Crawford (2007). Forecasting patterns of urbanization and the loss of natural and rural landscapes in the Carolinas piedmont. *GIS Day: Greater Charlotte Region*, Charlotte, North Carolina. [ORAL]

Crawford, C.J., and L.M. Kennedy (2007). Recent successional patterns in a high elevation forest-grass ecotone from tree-ring records of Frasier fir (*Abies fraseri*) and mountain ash (*Sorbus Americana*). *Southeastern Division of Association of American Geographers*, Charleston, South Carolina. [ORAL]

Crawford, C.J. (2008). The use of rule-based spatial modeling in tree-ring site selection: applications in dendroclimatology. *Association of American Geographers*, Boston, Massachusetts. [ORAL]

Crawford, C.J. (2009). Past and present climate variation in the Southern Appalachian Mountains. *Association of American Geographers*, Las Vegas, Nevada. [ORAL]

Crawford, C.J. and K.F. Kipfmueller (2010). Increasing the predictive power in tree-ring paleoclimatic calibration: the added value of multi-species network analysis. *Association of American Geographers*, Washington D.C. [ORAL]

Crawford, C.J. and K.F. Kipfmueller (2010). Low frequency variation in tree-ring chronologies: Evidence of the Pacific-North American Pattern from the Southern Appalachian and Northern Rocky Mountains, USA. *International Conference of Dendrochronology – WorldDendro 2010*, Rovanemni, Finland. [ORAL]

Crawford, C.J., S.M. Manson, and M.E. Bauer (2010). Time-series development for geophysical research: the role of historical Landsat remote sensing. *American Geophysical Union*, San Francisco, California. [POSTER]

Crawford, C.J., S.M. Manson, and M.E. Bauer (2011). Monitoring mountain snowpack on historical timescales using Landsat remote sensing. *Association of American Geographers*, Seattle, Washington. [ORAL]

Crawford, C.J., S.M. Manson, M.E. Bauer (2011). Monitoring seasonal snow cover variability on historical timescales using Landsat remote sensing, *American Society for Photogrammetry and Remote Sensing*, Milwaukee, Wisconsin. [POSTER]

Crawford, C.J., M.E. Bauer, S.M. Manson (2011). Multitemporal snow cover mapping in mountainous terrain using Landsat remote sensing, *PECORA 18*, Herndon, Virginia. [POSTER]

Crawford, C.J., K.F. Kipfmueller, and S. St. George (2011). Moisture-sensitive tree-ring widths from the Craters of the Moon lava-complex in east-central Idaho, USA. *American Geophysical Union*, San F rancisco, California. [POSTER]

Crawford, C.J. (2012). Do high-elevation northern red oak tree-rings share a common-climate driven growth signal? *Association of American Geographers*, New York, New York. [ORAL]

Crawford, C.J. (2012). Monitoring historical mountain snowpack extent across western North America: climate data record (CDR) development from Landsat and MODIS. *MtnClim 2012*, Estes Park, Colorado. [POSTER]

Crawford, C.J., K.F. Kipfmueller, and S. St. George (2012). Proxy-based annual and seasonal precipitation estimates for the Craters of the Moon lava-complex and eastern Snake River Plain. *American Geophysical Union*, San Francisco, California. [POSTER]

Crawford, C.J., K.F. Kipfmueller, M.W. Salzer, M. Torbenson, and S. St. George (2013). Frost-ring formation in Douglas-fir at the lower forest border. *Second American Dendrochronology Conference (AmeriDendro 2013)*, Tucson, Arizona. [ORAL]

Hall, D.K., C.J. Crawford, J.L. Foster, N.E. DiGirolamo, and G.A. Riggs (2013). Changing temperature, snow cover and stream discharge in the western United States, Wind River Range, Wyoming, USA. *2013 EUMETSAT Meteorological Satellite Conference / 19th American Meteorological Society Satellite Meteorology, Oceanography, and Climatology Conference*, Vienna, Austria. [ORAL]

Crawford, C.J. (2013). Evidence for spring mountain snowpack retreat from a Landsat-derived snow cover climate data record, central Idaho and southwestern Montana, USA. *American Geophysical Union*, San Francisco, California. [POSTER]

Elliott, G. and C.J. Crawford (2014). Coupling remote sensing and dendroecological techniques to examine how wind-snow interactions mediate treeline advance. *Association of American Geographers*, Tampa, Florida. [ORAL]

Hall, D.K., C.J. Crawford, N.E. DiGirolamo, G.A. Riggs, and J.L. Foster (2014). Satellite-derived snow cover, surface temperature and snow-water equivalent in the Green River Basin, Wyoming, to improve prediction of stream discharge. *71st Eastern Snow Conference*, Boone, North Carolina. [ORAL]

Crawford, C.J. and D.K. Hall (2014). Landsat climate data record development for seasonal snow cover study in mountainous terrain. *71st Eastern Snow Conference*, Boone, North Carolina. [POSTER]

Crawford, C.J. and D.K. Hall (2014). Accuracy standards for partially cloudy Landsat visible/infrared snow maps. *SnowPEx, 1st International Satellite Snow Product Intercomparison Workshop (ISSPI)*, NOAA Center for Weather and Climate Prediction, College Park, Maryland. [ORAL]

Crawford, C.J., D.K. Hall, N.E. DiGirolamo, G.A. Riggs, and J.L. Foster (2014). Snowmelt runoff modeling in the Upper Colorado River Basin using MODIS fractional snow cover. *CIRMOUNT MtnClim 2014*, Midway, Utah. [ORAL]

Crawford, C.J. and D.K. Hall (2014). Accuracy standards for Landsat climate data records: An assessment of cloud/cloud shadow masking over snow-covered surfaces. *PECORA 19 / ISPRS Commission 1 / IAG 4 Symposium*, Denver, Colorado. [ORAL]

Crawford, C.J., D.K. Hall, N.E. DiGirolamo, G.A. Riggs, and J.L. Foster (2015). Snowmelt runoff modeling in the Wind River Range, Wyoming using MODIS Collection 6 fractional snow cover. *Association of American Geographers*, Chicago, Illinois. [ORAL]

Crawford, C.J., D.K. Hall, N.E. DiGirolamo, G.A. Riggs, and J.L. Foster (2015). Snowmelt runoff modeling in the Wind River Range, Wyoming using MODIS Collection 6 fractional snow cover. *2015 Young Scientist Forum, NASA/GSFC*, Greenbelt, Maryland. [ORAL]

Crawford, C.J. (2015). The seasonality of snow/cloud discrimination in Landsat imagery across the Northern Hemisphere. *2nd ESA SnowPEx Workshop*, Boulder, Colorado. [POSTER]

Ripper, E., G. Bippus, T. Nagler, S. Metsamaki, R. Solberg, C.J. Crawford, and K. Rittger (2015). Landsat Reference Data: Status, Validation Methods, and First Results. *2nd ESA SnowPEx Workshop*, Boulder, Colorado. [ORAL]

Kim, E., C. Gatebe, D.K. Hall, M. Sturm, L. Brucker, C.J. Crawford, and D.K. Kang (2015). The NASA SnowEx airborne campaign: an upcoming opportunity for the SnowPEx community. *2nd ESA SnowPEx Workshop*, Boulder, Colorado. [ORAL]

Crawford, C.J., P.K. Campbell, E.M. Middleton, D.K. Hall, M.G. Hom, K.R. Huemmerich, and D.R. Landis (2016). Retrieval of Lake Superior ice surfaces using EO-1 Hyperion, Landsat ETM+, and Landsat OLI. *23rd IAHR International Symposium on Ice, University of Michigan*, Ann Arbor, Michigan. [ORAL]

Crawford, C.J., P.K. Campbell, E.M. Middleton, D.K. Hall, M.G. Hom, K.R. Huemmerich, and D.R. Landis (2016). Why spectral resolution matters for inland lake ice mapping: a Lake Superior inter-comparison study using EO-1 and Landsat Earth observations. *6th Annual HyspIRI Data Products Symposium, NASA Goddard Space Flight Center*, Greenbelt, Maryland. [ORAL]

Invited Presentations

Crawford, C.J. (2013). Annual and sub-annual precipitation reconstructions for the Craters of the Moon lava complex, eastern Snake River Plain, USA. *University of Minnesota Quaternary Paleoecology Spring Seminar*, St. Paul, Minnesota.

Crawford, C.J. (2013). A paleo-perspective on precipitation seasonality from central Idaho tree rings *Laboratory of Tree-Ring Research, University of Arizona*, Tucson, Arizona.

Crawford, C.J. (2013). Path-to-Goddard: an acknowledgement. *Cryospheric Sciences Laboratory*, *NASA Goddard Space Flight Center*, Greenbelt, Maryland.

Crawford, C.J. (2014). Multi-sensor snow cover climate data records: method, validation, and inference. *Terrestrial Water Cycle Seminar*, *Hydrological Sciences Laboratory*, *NASA Goddard Space Flight Center*, Greenbelt, Maryland.

Crawford, C.J. (2014). Is the western United States precipitation dipole evident in central Idaho tree rings? *Woods Hole Oceanographic Institution,* Woods Hole, Massachusetts.

Crawford, C.J. (2016). Realizing the value of Landsat Earth observations in a rapidly changing climate system. *United States Geological Survey, Earth Resources Observation and Science Center,* Sioux Falls, South Dakota

Grants

Research Grants

2006 Sidman Poole Scholarship, Department of Geography, Virginia Tech (5/1/2006-6/31/2006). *Participation in the 2006 Laboratory for Tree Ring Research (LTRR) Summer School at the University of Arizona*. P.I. C.J. Crawford ($500). Supported travel, lodging, and food expenses during the LTRR Summer School.

Department of Geography Alumni Grant, Department of Geography, Virginia Tech (7/01/2006-8/15/2006). *Dendroclimatic reconstructions from two southern Appalachian balds.* P.I. C.J. Crawford ($200). Supported tree-ring data collection for master's research on assessing the potential of open-grown high elevation trees to reconstruct past climate variability across the Southern Appalachian mountain range.

Graduate Research Development Grant, Virginia Tech Graduate School (7/01/2006-8/15/2006). *Dendroclimatic reconstructions from two southern Appalachian balds.* P.I. C.J. Crawford ($200). Supported tree-ring data collection for master's research on assessing the potential of open-grown high elevation trees to reconstruct past climate variability across the Southern Appalachian mountain range.

2007 Sidman Poole Scholarship, Department of Geography, Virginia Tech (4/01/2007-5/31/2006). *Conference travel and tree-ring data collection*. P.I. C.J. Crawford ($500). Supported travel to the 2007 Association of American Geographers Annual Meeting and additional tree-ring data collection.

2009 Adams-Abler Summer Field Fellowship, Department of Geography, University of Minnesota (6/15/2009-8/31/2009). *Summer research stipend and tree-ring data collection*. P.I. C.J. Crawford ($2500). Provided a summer research salary and supported data collection for dissertation research on tree-ring based paleoclimate reconstructions for the northern Rocky Mountains.

2010 College of Liberal Arts Dissertation Research Grant, University of Minnesota (6/15/2010-8/31/2010). *Assessing Historical Trends in Snowpack Variability across the Northern Rocky Mountains using Dendrochronology and Remote Sensing Approaches.* P.I. C.J. Crawford ($400). Supported tree-ring and Landsat data collection for dissertation research.

Graduate Research Partnership Program (GRPP) Grant, College of Liberal Arts, University of Minnesota (6/15/2010-8/31/2010). *Assessing Historical Trends in Snowpack Variability across*

the Northern Rocky Mountains using Dendrochronology and Remote Sensing Approaches. P.I. C.J. Crawford ($4000). Provided a summer research salary and supported tree-ring and Landsat data collection for dissertation research.

Graduate School Thesis Grant, University of Minnesota (6/15/2010-8/31/2010). *Assessing Historical Trends in Snowpack Variability across the Northern Rocky Mountains using Dendrochronology and Remote Sensing Approaches*. P.I. C.J. Crawford ($2427). Supported tree-ring and Landsat data collection for dissertation research.

AAG Dissertation Research Grant, AAG (6/15/2010-8/31/2010). *Assessing Historical Trends in Snowpack Variability across the Northern Rocky Mountains using Dendrochronology and Remote Sensing Approaches*. C.J. Crawford ($500). Supported tree-ring and Landsat data collection for dissertation research.

Paleoenvironmental Change Student Research Grant, AAG Paleoenvironmental Change Specialty Group (6/15/2010-8/31/2010). *Low Frequency Ocean-Atmosphere Climate Dynamics from Upper and Lower Forest Border Tree-Ring Chronologies in the Northern Rocky Mountains.* P.I. C.J. Crawford ($200). Supported tree-ring data collection for paleoclimate reconstructions across the northern Rocky Mountains.

Chimborazo Student Research Grant, AAG Mountain Geography Specialty Group (4/01/2010-3/31/2011). *Assessing Multitemporal Seasonal Snow Cover Variability across the Northern Rocky Mountains using Landsat Remote Sensing.* P.I. C.J. Crawford ($500). Supported development of historical Landsat snow cover products for the interior northwestern mountains, USA.

NASA Earth and Space Science Fellowship, NASA (9/01/2010-8/31/2011). *Assessing Multitemporal Seasonal Snow Cover Variability across the Northern Rocky Mountains using Landsat Remote Sensing.* P.I. C.J. Crawford ($29,806). Supported development of historical Landsat snow cover products for the interior northwestern, USA.

2011 NASA Earth and Space Science Fellowship, NASA (9/01/2011-8/31/2012). *Assessing Multitemporal Seasonal Snow Cover Variability across the Northern Rocky Mountains using Landsat Remote Sensing.* P.I. C.J. Crawford ($29,981). Supported development of historical Landsat snow cover products for the interior northwestern, USA.

American Alpine Club Research Grant, American Alpine Club (8/15/2011-8/15/2012). *Tracking Abrupt Temperature Change across Alpine Environments of Interior Northwestern, USA*. P.I. C.J. Crawford ($700). Supported tree-ring data collection for paleo-temperature reconstructions across the mountains of central Idaho and southwestern Montana, USA.

2012 College of Liberal Arts Dissertation Grant, University of Minnesota (4/01/2012-3/31/2013). *Dissertation Research Grant.* P.I. C.J. Crawford ($625). Supported final stages of dissertation research completion including primary data archiving and storage, research travel, and publication page charges.

NASA Earth and Space Science Fellowship, NASA (9/01/2012-8/31/2013). *Assessing Multitemporal Seasonal Snow Cover Variability across the Northern Rocky Mountains using Landsat Remote Sensing.* P.I. C.J. Crawford ($29,994). Supported development of historical Landsat snow cover products for the interior northwestern, USA

2013 NASA Postdoctoral Program Fellowship, ORAU / NASA (8/11/2013-8/10/2014). *Monitoring Climate-Driven Changes in Mountain Snowpack Extent across the Western United States: A Multi-Sensor Approach to Climate Data Record Development using Landsat, MODIS, and VIIRS.* P.I. C.J. Crawford ($78,275). Supported development of multi-satellite snow cover climate data records for western US mountain snowpack extent monitoring.

2014 NASA Postdoctoral Program Fellowship, ORAU / NASA (8/11/2014-8/10/2015). *Monitoring Climate-Driven Changes in Mountain Snowpack Extent across the Western United States: A Multi-Sensor Approach to Climate Data Record Development using Landsat, MODIS, and VIIRS.* P.I. C.J. Crawford ($79,775). Supported development of multi-satellite snow cover climate data records for western US mountain snowpack extent monitoring.

Travel Grants

2010 College of Liberal Arts Travel Grant, University of Minnesota (6/01/2010-6/30/2010). *Travel to the International Conference on Dendrochronology – WorldDendro 2010 in Rovaniemni, Finland.* P.I. C.J. Crawford ($400). Supported international travel to give a paper presentation on dissertation research.

International Geographic Fund (IGIF) Travel Grant, AAG (6/01/2010-6/30/2010). *Student travel grant for International Conference on Dendrochronology – WorldDendro 2010 in Rovaniemni, Finland.* P.I. C.J. Crawford ($100). Supported international travel to give a paper presentation on dissertation research.

ASPRS Student Assistantship Grant, American Society for Photogrammetry and Remote Sensing (ASPRS) (4/25/2010-4/30/2010). *Stipend for student assistantship including lodging, airfare, and conference registration*. P.I. C.J. Crawford ($100). Supported travel expenses during the annual meeting in San Diego, CA.

2011 College of Liberal Arts Travel Grant, University of Minnesota (6/01/2011-11/15/2011). *Travel to NASA Goddard Space Flight Center during fall 2011.* P.I. C.J. Crawford ($330). Supported visiting fellow travel to NASA/GSFC during fall 2011.

2013 College of Liberal Arts Travel Grant, University of Minnesota (4/01/2013-8/31/2013). *Travel to AmeriDendro 2013.* P.I. C.J. Crawford ($1130). Supported conference travel to AmeriDendro 2013 at the Laboratory of Tree-Ring Research, University of Arizona for oral presentation of a research paper.

Council of Graduate Students Travel Grant, University of Minnesota (1/01/2013-8/31/2013). *Travel to AmeriDendro 2013.* P.I. C.J. Crawford ($450). Supported conference travel to

AmeriDendro 2013 at the Laboratory of Tree-Ring Research, University of Arizona for oral presentation of a research paper.

Research Project Experience

Airborne Science

2015 *SIMPL/AVIRIS-NG 2015 Greenland Mission*. PIs Dave Harding, NASA/GSFC and Kelly Brunt, ESSIC/University of Maryland. Crawford's Role: ASD Instrument Scientist PI for the airborne mission. This NASA funded airborne campaign was in support of the ICESat-2 mission. Airborne observations of laser altimetry, non-imaging spectroscopy, and imaging spectroscopy were collected for the Greenland ice sheet, Arctic sea ice, and the Arctic Ocean.

Remote Sensing / GIS

2007–2008 *Forecasting Patterns of Urbanization and the Loss of Natural and Rural Landscapes in the Carolinas Piedmont.* P.I. Ross Menteemeyer, CAGIS, University of North Carolina-Charlotte. Crawford's Role: Prepared, processed, and analyzed historical aerial photography, satellite imagery, and ancillary GIS data to map historical land-use/landcover for characterization of landscape scale change in the central piedmont of North Carolina.

2009–2010 *North American Land Change: Decision Making in Coupled Human-Environment Systems*. P.I. Steve Manson, University of Minnesota. Crawford's Role: Blended multiple remotely sensed land cover classifications to develop a hybrid global datasets for land-use characterization.

Climatology / Dendrochronology / Paleoenvironmental

2007 *Paleoenvironmental research in the Dominican Republic*. P.I. Lisa Kennedy, Virginia Tech. Crawford's Role: Assisted in the collection of costal lake sediments to identify historic hurricane deposition.

2008 *Multi-scale analysis of tree-line in response to climate change in the Rocky Mountains.* P.I. Grant Elliott, University of Minnesota. Crawford's Role: Assisted in tree-ring data collection at multiple tree-line sites in the Rocky Mountains.

2008–2009 *Impacts of historical climate variability on crop yields in Minnesota.* P.I. Kathy Klink, University of Minnesota. Crawford's Role: Analyzed and modeled instrumental climate data with experimental crop data to examine impacts of climate change on grain yields in Minnesota.

Teaching

Courses Taught

Chief Instructor, *University of Minnesota, Minneapolis, MN* (2012)

- GEOG 1421: Introduction to Meteorology/The Atmosphere (Lab)

Chief Instructor, *University of Minnesota, Minneapolis, MN* (2010)
- GEOG 1421: Introduction to Meteorology/The Atmosphere (Lab)

Chief Instructor, *University of North Carolina-Charlotte, Charlotte, NC* (2008)
- ESCI 1101: Introduction to Earth Systems Science (Lecture)

Chief Instructor, *Kings College, Charlotte, NC* (2007)
- GS 202: Physical Geography (Lecture)

Chief Instructor, *Virginia Tech, Blacksburg, VA* (2006)
- GEOG 4084/5084: Introduction to Geographic Information Systems (Lab)
- GEOG 2314: Maps and Mapping (Lab)

Guest Lectures

Guest Lecturer, *University of Maryland Baltimore County* (2016)
- GEOG 4034: Arctic Geography

Guest Lecturer, *University of Maryland Baltimore County* (2014)
- GEOG 4034: Arctic Geography

Guest Lecturer, *University of Minnesota, Minneapolis, MN* (2012)
- ANTH 4069: Environmental Archaeology

Guest Lecturer, *University of Minnesota, Minneapolis, MN* (2012)
- GEOG 1403: Biogeography

Guest Lecturer, *University of Minnesota, Minneapolis, MN* (2011)
- GEOG 3839/5839: Introduction to Dendrochronology

Guest Lecturer, *University of Minnesota, Minneapolis, MN* (2009)
- EEB 4609/5609: Ecosystem Ecology

Courses Assisted

Teaching Assistant, *University of Minnesota, Minneapolis, MN* (2012)
- GEOG 1421: Introduction to Meteorology/The Atmosphere (Lecture)

Teaching Assistant, *University of Minnesota, Minneapolis, MN* (2010)
- GEOG 1421: Introduction to Meteorology/The Atmosphere (Lecture)

Teaching Assistant, *Virginia Tech, Blacksburg, VA* (2006 – 2007)
- GEOG 3954: Study Abroad in the Dominican Republic (Introduction to Physical and Human Geography of the Caribbean) (Lecture/Lab)
- GEOG 1004: Human Geography (Lecture)
- GEOG 4084/5084: Introduction to Geographic Information Systems (Lecture)
- GEOG 2314: Maps and Mapping (Lecture)

Professional Service

Journal Reviewing

2011	Tree-Ring Research
2012	Climatic Change
2012	Tree-Ring Research

2012	Climate Dynamics
2013	Dendrochronologia
2013	Remote Sensing of Environment
2013	Climate Dynamics
2014	Remote Sensing of Environment
2014	IEEE, Journal of Selected Topics in Applied Earth Observation and Remote Sensing (JSTARS)
2014	Dendrochronologia
2015	Remote Sensing of Environment
2015	IEEE, Geoscience and Remote Sensing
2015	International Journal of Remote Sensing
2015	Journal of Geophysical Research-Biogeosciences
2015	Journal of Hydrometeorology
2016	Nature Scientific Reports
2016	Remote Sensing of Environment

Institutional

2007	Participant, Teaching Workshop, *Improving Student Attitudes: The Key to Success*, Department of Education, Kings College
2009 – 2010	Graduate Student Representative, Department of Geography, University of Minnesota-Twin Cites
2010 – 2011	Member, Health Geography Position Search Committee, Department of Geography, University of Minnesota-Twin Cities
2016	NASA/GSFC Science Proposal Support Office (SPSO) Red Team Reviewer
2016	NASA Research Opportunities in Space and Earth Science (ROSES) Panel Reviewer

National

2010	Member, Mountain Geography Specialty Group Awards Committee, AAG
2010	American Society for Photogrammetry and Remote Sensing Student Assistant for the annual meeting
2011	AAG annual conference paper session organizer, *Multitemporal Remote Sensing of Snow and Ice*
2011 – 2013	Board of Directors, Cryosphere Specialty Group, AAG
2012	AAG annual conference session chair, *Dendrochronology III – Dendroclimatology*
2014	National Science Foundation (NSF) Proposal Reviewer, Hydrologic Sciences Competition, Spring 2014 Panel
2014	AAG Panelist, *Strategies for Acquiring and Succeeding in Post-Doc, Faculty, and Government Positions*

Professional Development

Workshops

2013	*1St NASA International Snow Working Group Remote Sensing (iSWGR) Meeting*, Cooperative Institute for Research in Environmental Sciences (CIRES), Boulder, Colorado
2014	*Communicating Your Message for Research and Analysis Proposals*, Science Proposal Support Office (SPSO), NASA/GSFC, Greenbelt, Maryland
2014	*PANalytical NIR/ASD Remote Sensing Course*, PANalytical NIR Excellence Center, Boulder, Colorado
2014	*International Snow Products Intercomparison and Evaluation and Experiment (SnowPEx) 1St Workshop,* NOAA Weather and Climate Prediction Center, College Park, Maryland
2015	*International Snow Products Intercomparison and Evaluation and Experiment (SnowPEx) 2nd Workshop,* University of Colorado-Boulder, Boulder, Colorado
2016	4th *NASA iSWGR/SnowEx/ASO Meeting*, University of Washington, Seattle, Washington

Professional Experience and Memberships

2003	Forestry Technician, *USDA Forest Service, White River National Forest, Carbondale, Colorado*
2004	Forestry Technician, *USDA Forest Service, Salmon-Challis National Forest, Salmon, Idaho*
2005	Fuels Technician/Helitack, *USDA Forest Service, Salmon-Challis National Forest, Salmon, Idaho*
2006 – 2009	Member, Southeastern Division of AAG
2006 – date	Member, AAG
2007 – 2013	Member, Tree Ring Society
2008 – 2012	Member, Climate Specialty Group, AAG
2008 – 2012	Member, Paleoenvironmental Specialty Group, AAG
2009 – 2012	Member, Mountain Geography Specialty Group, AAG
2009 – date	Member, Cryosphere Specialty Group, AAG
2009 – date	Member, ASPRS
2010 – date	Member, American Geophysical Union (AGU)