2023

U.S. National Report TO THE ICA

contents

Cartography and GIS in the United States, 2019–2023

Compiled by the U.S. National Committee (USNC) for the International Cartographic Association (ICA), this year's National Report to the ICA recounts significant advancements and activities in cartography and GIS in the United States of America over the last four years. This report is made available to the public via the ICA website and the CaGIS website to allow everyone to gain an overview of national and global activities within the cartography and GIScience community. The 2023 report will be presented in August to the ICA General Assembly at the International Cartographic Conference in Cape Town, South Africa.

A NOTE ABOUT THE FORMAT

The 2023 National Report incorporates a draft template that the ICA may use to solicit future reports. The template is reflected in the Contributor Profiles at the end of this report.

Non-profit Organizations and Societies

There are a variety of non-profit societies and associations that focus on cartography in the United States. Each has a different strength. For example, CaGIS focuses its support on cartographic research in academia and the government. NACIS supports commercial and academic cartography, as well as map librarians. The AAG CSG supports cartography within academic geography. UCGIS supports GIS in higher education. The IMIA, while international, provides support for U.S. map making, publishing and distributing companies and agencies. These non-profit organizations often work together to support cartography and GIS in the U.S.

CAGIS

The Cartography and Geographic Information Society (CaGIS) supports research, education, and practice to improve the understanding, creation, analysis, and use of maps and geographic information for effective decision-making and to improve the quality of life. The Society serves as a forum for the exchange of original concepts, techniques, approaches, and experiences by those who design, implement, and use cartography, GIS, and related geospatial technologies.

NACIS

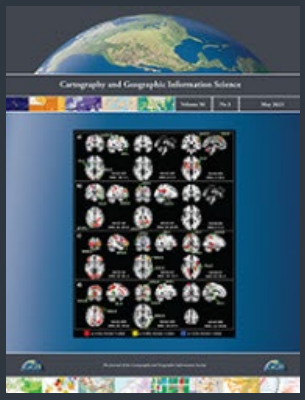
The North American Cartographic Information Society (NACIS) is an organization of specialists in the field of geographic information. Founded in 1980, NACIS has grown into a vibrant society with membership throughout North America and the world. NACIS welcomes new members from traditional as well as emerging professions that define geographic information science today.

AAG CSG

The Cartography Specialty Group (CSG) of the American Association of Geographers (AAG) encourages cartographic research and promotes education in cartography and map use. It facilitates the exchange of ideas and information about cartography, promotes interest in and correct utilization of maps, promotes and facilitates the cartographer's role within the geographic profession, and promotes and coordinates activities and directions with other professional organizations involved with cartography.

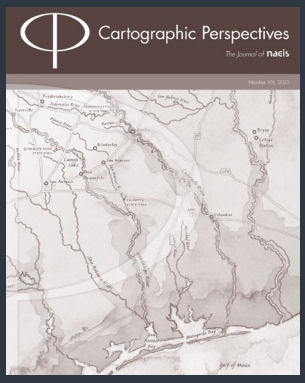
Spotlight: *CaGIS*

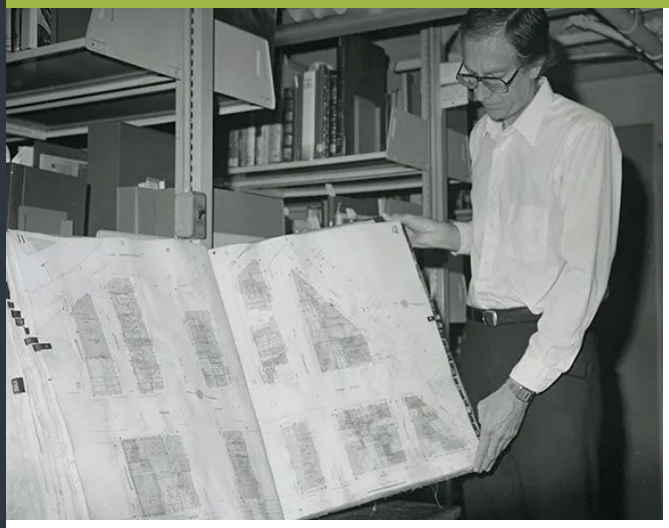
Cartography and Geographic Information Science (*CaGIS*) is the official publication of the Cartography and Geographic Information Society. Published six times per year, the journal may be accessed online via the Taylor and Francis website and members can access the journal online via the CaGIS website.



Spotlight: *Cartographic Perspectives*

Cartographic Perspectives (CP) is the free, open-access journal of NACIS, devoted to the study and practice of Cartography in all of its diversity. It is published three times a year. The 100th issue was released in January 2023!





Non-profit Organizations and Societies

bring cartography and GIS community members together to share their work and plan for the future.

UCGIS

The University Consortium for Geographic Information Science (UCGIS) is a non-profit organization that creates and supports communities of practice for GIScience research, education, and policy endeavors in higher education and with allied institutions. We are the professional hub for the academic GIS community in the United States, with partnerships extending this capacity abroad.

IMIA

The International Map Industry Association (IMIA) is dedicated to fostering the growth of the mapping industry through the exchange of ideas and information, the education of industry trends and technologies, and access to a wide spectrum of mapping leaders. Our global organization is one collective group with one voice advocating for the growth and success of the international mapping industry. Connecting the business of maps worldwide is our number one priority.

Map Librarians

The American Library Association maintains an online guide to U.S. map collections. It also provides a list of national and international professional organizations concerned with maps. The Western Association of Map Libraries (see spotlight at right) provides a similar list of national and international map library organizations. However, corporate libraries are often overlooked.

Esri Library

The Esri Library serves as a research destination for Esri employees working on software development, educational training and industry applications of GIS. The Esri Library is also committed to contributing GIS information to educators, students and the GIS community, through the publicly accessible Esri GIS Bibliography. The Esri Library collection has grown to over 100,000 items, including print and electronic materials.

Spotlight: Western Association of Map Libraries

The Western Association of Map Libraries (WAML) is an independent association of map librarians and other people interested in advancing geospatial excellence in libraries of western North America and beyond.

The Information Bulletin (IB) is the official journal of the Western Association of Map Libraries. It is an open access journal issued three times each year.

The WAML Annual Conference provides a great opportunity for students or new/transitioning librarians to learn, network, and develop themselves and the profession of Map and GIS librarianship.The 2023 meeting is being held in August at the University of Brisitsh Columbia an in-person event with select sessions live-streamed.

WAML also offers scholarships and distinguished service award (see page 7 for more details).

Spotlight: Penn State Geography

The Department of Geography at The Pennsylvania State University is committed to building a resilient and just world by bridging the subfields of geography to identify innovative and creative social, environmental, and spatial solutions. It seeks these solutions through its teaching, research, and service by advancing the vision of how to sustain landscapes and livelihoods, respond to the climate crisis, and make data science spatial. The department sees these as grand challenges for Penn State Geography.

In 2021, the ICA Carl Mannerfelt Gold Medal was awarded to Alan M. MacEachren (shown abve right), Professor Emeritus of Geography at Penn State University. Alan is the founding director of the Geo-VISTA Center, one of the premier research and design laboratories in cartography, geovisualization, and GIScience in the U.S. Alan is an inter-nationally recognized leader in these areas, pioneering methods to interact and collaborate in real-time exploratory analyses and visualizations of geographic data sets. Alan was named an Honorary Fellow of the ICA in 2005, but the scope, and impact of his scientific contributions bring the ICA to award him the Mannerfelt Medal.

Academic Programs

Often found within geography departments, cartography remains a strong discipline in U.S. academia

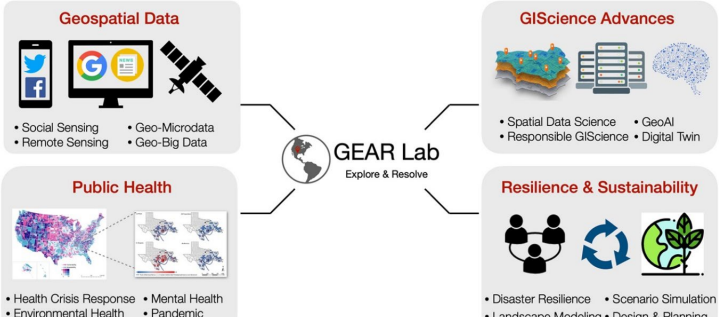
According to College Factual with information about 2023 schools with degrees in Geography and Cartography, there are 8 associate, 216 undergraduate, 115 master's, and 47 doctor's degree schools in the U.S. Online programs in cartography in 2021 have also been listed.

University of Oregon

The CartoFish Lab, directed by Dr. Carolyn Fish, is focused on research at the intersection of cartography and environmental communication. We research how to effectively communicate climate change through maps and the ways in which maps are used in climate change discourse. We use a combination of quantitative and qualitative methods and analysis to illustrate how the media and scientists create and design maps that balance communication and scientific accuracy.

Texas A&M University

The mission of the Geospatial Exploration and Resolution Lab in the Department of Geography at Texas A&M University (TAMU) is to build a healthy, resilient, and sustainable future for human communities amidst changing climates and environments through spatial and responsible thinking, novel data, and intelligent algorithms. We aim to explore diverse geospatial data and analysis methods, advance GIScience theories and algorithms, and resolve real-world challenges and societal needs.



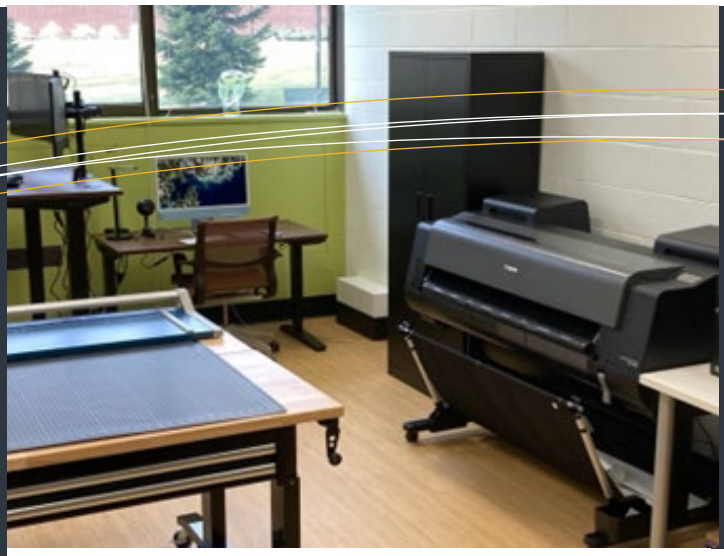
Spotlight: Smithsonian Institution

The Smithsonian Institution is the world's largest museum, education, and research complex. It includes 21 museums, the National Zoo, and eight research centers.

The SI Vision: "Through our unparalleled collections and research capabilities, and the insight and creativity we foster through art, history, and culture, the Smithsonian strives to provide Americans and the world with the tools and information they need to forge Our Shared Future".

The Institution was founded in 1846 with funds from the Englishman James Smithson (1765–1829) according to his wishes "under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge." We continue to honor this mission and invite you to join us in our quest.

Spotlight: GeoGraphics Lab – PSU



University Cartography/ GIS Labs

University labs serve a wide variety of clients and functions

Located in the Penn State University Department of Geography, the GeoGraphics Lab provides cartographic design, production, and research services using industry-grade equipment (as shown at the right). Its clients include commercial, nonprofit, and government organizations, members of the central Pennsylvania community, as well as PSU Geography students and faculty. The lab offers professional geospatial visualization services, inclu-ding map design, production, and research. The lab's specialty is static print and digital maps, but it offers solutions for interactive digital maps as well.

The lab is currently working with Dr. Cynthia Brewer to design maps for a renovation of the Eric A. Walker Building's 2nd and 3rd floors, which houses the PSU Department of Geography. The centerpiece will be a series of large (16 to 28 square foot), illuminated resin panels mounted to the wall (shown below right). Each map will feature a different continent, dataset, and themes in geography, while at the same time illustrating relationships between humans and the environment.

Cartography & GIS Labs on University Campuses

NACIS maintains a list of some forty university laboratories of Cartography, GIS and Remote Sensing, as well as university staff cartographers and geographic services.

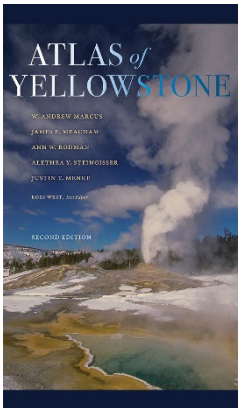
GAMLab – University of Colorado, Denver

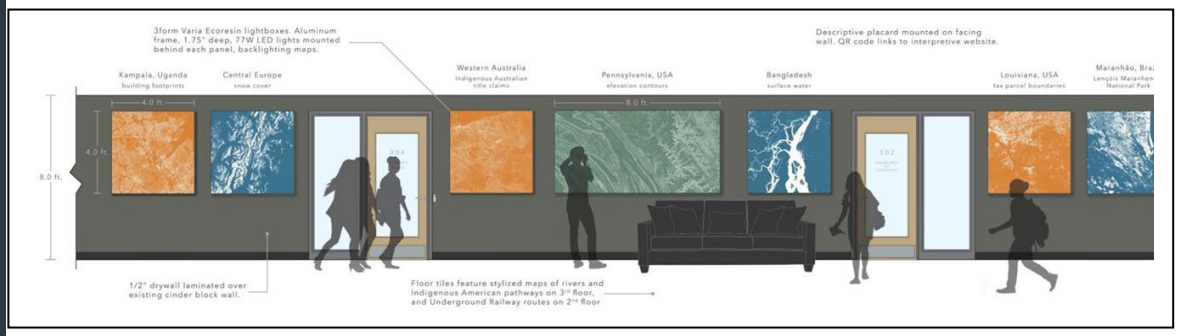
The Geospatial Analysis and Mapping Laboratory (GAMLab) is a newly established research and service center in the Department of Geography and Environmental Sciences at the University of Colorado Denver (CU Denver). The GAMLab provides resources and services to visualize, explore, analyze, and propose solutions to human-environmental challenges using GIScience and Technology. The GAMLab enables and supports the geospatial research activities of CU Denver's Department of Geography and Environmental Sciences (GES) faculty and students. The GAMLab offers services to both internal and external clients, including map production, informational graphics, digitizing, data compilation, spatial analysis, and consulting.

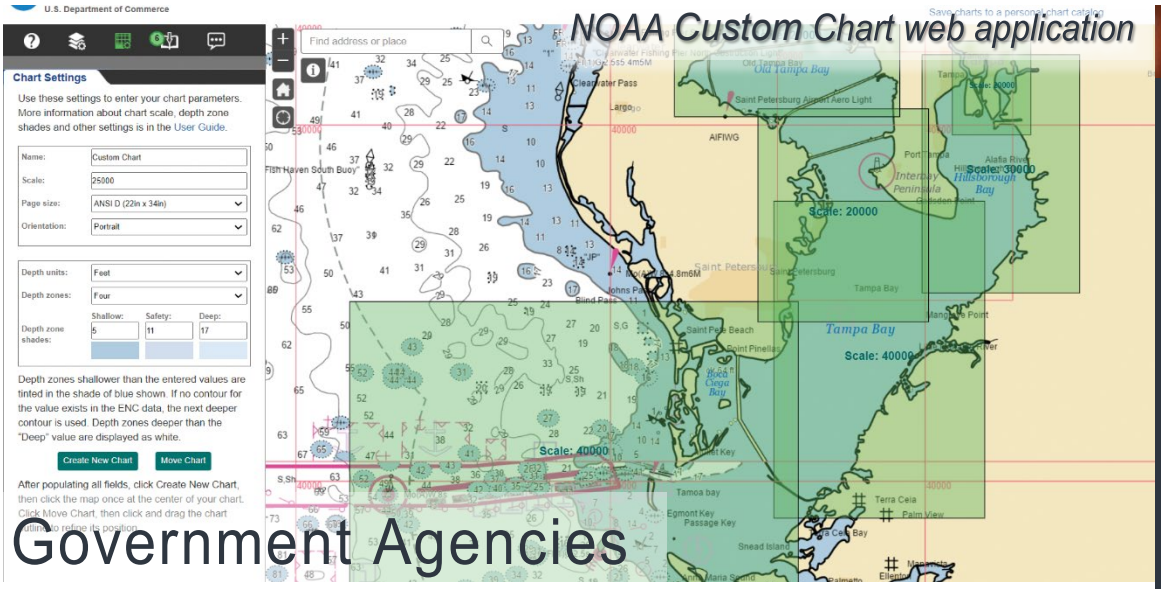
InfoGraphics Lab – University of Oregon

The InfoGraphics Lab (IGL) is a center of excellence and innovation in geospatial research and cartography at the University of Oregon. As a hybrid research and practice community, the IGL seeks to advance basic research in diverse domains and develop high quality interactive and print products that evoke, inspire and communicate. Ongoing research projects highlight the integral role—both technical and theoretical—that data and design play in advancing knowledge and making a meaningful impact on society and the planet.

Recent accomplishments include *The Atlas of Yellowstone, 2nd Edition*, three USGS reports on ungulate migration, and more than a dozen collaborations with faculty in a variety of disciplines within the university and beyond.







NOAA Custom Chart web application

Government Agencies

There are many U.S. government agencies involved with mapping and cartography, including the USGS (topographic mapping), Census Bureau (demographic data and maps), NOAA (nautical charting), as well as mapping by the NPS, FEMA, USFS, BLM, FWS, and others for the lands and programs that they oversee. Many of these agencies also provide GIS data, often for free. The University of Buffalo maintains a comprehensive list of maps and mapping resources from U.S. government agencies.

USGS CEGIS

The U.S. Geological Survey Center of Excellence for Geospatial Information Science (CEGIS) advances geospatial knowledge through cutting-edge research, innovative technologies, and collaborative partnerships. We aim to build a sustainable future by harnessing the power of geospatial information to support informed decision-making, scientific discovery, and environmental stewardship. CEGIS is in the Research Arm of the National Geospatial Program, part of the National Geospatial Directorate.

CEGIS aims to guide The National Map (TNM) towards an intelligent National Map (INM) in the next five years. The INM will utilize interactive tools to aid scientific discovery and inform decisions. It will be accessible to USGS scientists, Department of the Interior personnel, federal land managers, state and tribal government officials, non-government organizations, and the general public. The INM will support advanced retrievals based on geographic location, layers, feature names, and selection. It will also support mobile, download, and offline access.

Spotlight: NOAA

Office of Coast Survey

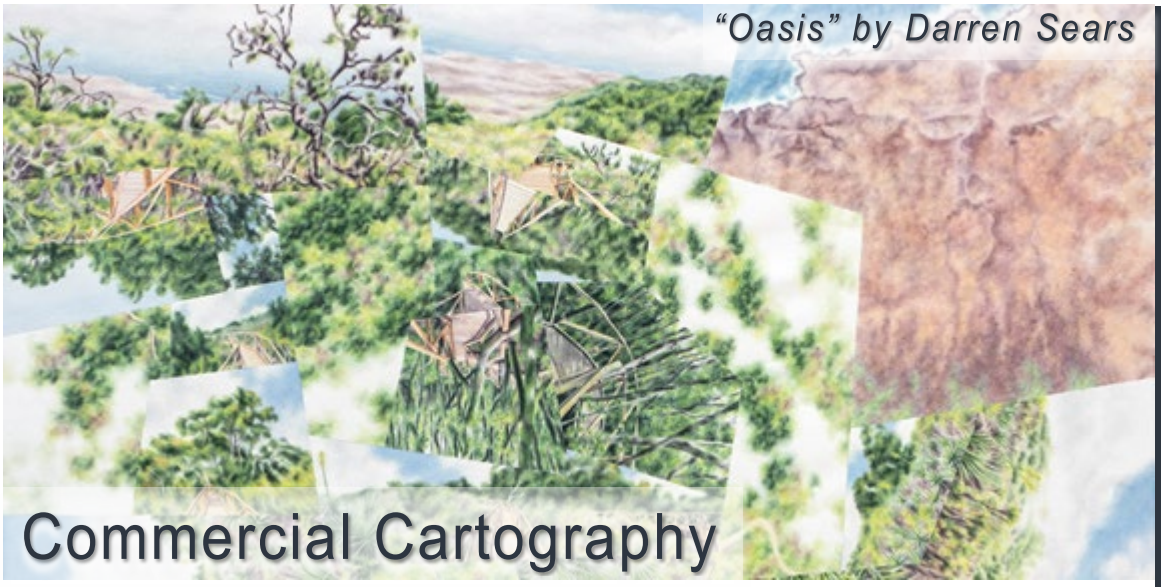
NOAA electronic navigational charts (ENCs) are vector files of chart features available in S-57 format. NOAA ENC® products support marine navigation by providing the official data used in ECDIS and in electronic charting systems. Starting in 2019, the NOAA Office of Coast Survey, Marine Chart Division (MCD) began the process of rescheming (i.e., redesigning the scheme of) their ENC suite, initially based on legacy chart extents digitized from paper nautical chart products to a rectangular tiled grid.

An additional goal of redesigning the ENC schema was to improve the overall useability of the ENC products in preparation for the cancellation of NOAA's paper chart suite. As of August 2023, NOAA has discontinued nearly 50% of its paper charts. To support users who still wish to have hard-copy nautical charts, NOAA has implemented the NOAA Custom Chart web application that allows mariners to create paper charts derived from ENC data. The image at the top of this page shows the NOAA Custom Chart application. Learn more at https://nauticalcharts.noaa.gov/.

Spotlight: Census Bureau

The U.S. Census Bureau and the Geographic Support Program (GSP) supports and maintains the geographic and cartographic infrastructure necessary for the Census Bureau's data collection processing, tabulation, and dissemination programs for the United States, Puerto Rico, and Island Areas. This program aims to provide the most current, accurate, and complete address, feature, imagery, and boundary data to the Census Bureau's customers and data users and build the geographic foundation for every economic and social data product produced by the Census Bureau. This program provides the geographic reference files that are needed for all Census Bureau programs, censuses, surveys, and related field operations, such as the Economic Census, the Current Demographic Statistics program, the Intercensal Demographic Estimates program, the American Community Survey (ACS), and the Decennial Census.

The Census Bureau integrates high-quality data provided by more than 40,000 tribal, federal, state, and local government partners to validate and update address, feature, and boundary information in the MAF/TIGER System.



Commercial Cartography

Commercial cartography has never been stronger in the U.S. NACIS maintains a list of over forty of its members with commercial ventures that specialize in producing maps for clients. IMIA also provides information about commercial cartography companies with information on its members in the international mapping industry. Also of great importance, but often overlooked, are our many independent cartographers!

Treeline Terrains

Inspired by their shared love of skiing in Vermont, Treeline Terrains founders Jacob, Nathaniel, and Alex searched for a creative way to capture their outdoor winter experiences.

Using satellite mapping technology, they brought their idea to the woodshop to create perfectly accurate 3D models. Today, Treeline Terrains captures the topography of the places in its wood-carved models.

Spotlight: Independent Cartographer, Darren Sears

My artistic watercolor maps are "fractured" into multiple landscapes inspired by my own photography, conveying immersive spatial experiences of natural environments in ways that individual aerial views cannot. These multi-faceted compositions accentuate the contrasts (generated by substrate, climate, or land use) that define ecological islands and archipelagos—geographies that feel to me like compressed, empoweringly "knowable" versions of natural spaces and phenomena that we typically think of as larger-than-life. The works are increasingly inspired by real (vs. imaginary) places worldwide, but they are abstract in not only sharpening contrasts but in distorting scales and orientations to reflect my real-world experiences.

The "world-at my-fingertips" sensation originally motivating these maps has recently evolved into a more preservation-minded urge as ecological edges and islands are degraded and obliterated by climate change and other threats. By continuing to emphasize separation and insularity, this emphasis on fragility represents a similar yearning for control—in this case relying on a simplistic idea of nature as historically isolated from change, human-caused and not, in time and space. This illusion of stability is only becoming more illusory, and my maps—grasping onto these endangered ecological slivers like precious objects—reveal my difficulty in accepting that reality.

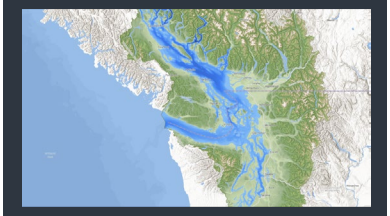
Spotlight: Esri

Esri is the global market leader in geographic information system (GIS) software, location intelligence, and mapping. Since 1969, it has supported customers with geographic science and geospatial analytics, what Esri calls The Science of Where. Esri takes a geographic approach to problem-solving, brought to life by modern GIS technology. The company is committed to using science and technology to build a sustainable world.

Esri mapping and analytics software inspires positive change across industries such as National Mapping. These organizations maintain information using GIS technology to effectively collect, manage, produce, and share base data for their nations.

Esri Map Galleries

Tour Esri's expansive collection of beautiful, innovative maps created by our global user community. These showcase the powerful capabilities of GIS technology and tells stories you'll want to explore.



2022 Esri UC: Climate of the Salish Sea Bioregion by Aquila Flower

Peace World by Addison Chrzanowski, Age 8

Spotlight:

Children's Map Competitions

The annual Children's Map Competition is a map competition for all children ages 15 years or younger. The goal of the contest is to promote the creative representation of the world in graphic form by children. It is offered every two years to celebrate the creativity, imagination, artistry, and wisdom of child mapmakers.

New and Improved by Crosby Price & Isabella Wilfling, Age 14

Six entries from the U.S. national competition are chosen to represent the United States in the international Petchenik Children's World Map Drawing Competition. This competition, now in its 28th year, was created by the International Cartographic Association to honor Dr. Barbara Bartz Petchenik.

Honors and Awards

Many U.S. organizations offer awards and honors to both students and professionals in Cartography and GIS to support and recognize their work.

CaGIS

CaGIS provided a number of awards in 2023, including Map Design Competition Awards; Children's Map Competition Awards; Student Scholarships; and Student Assistant Scholarships to attend AutoCarto 2022. CaGIS also presented two Distinguished Career Awards.

- **CaGIS Rising Grants**

  In 2021, CaGIS initiated a new grant program, CaGIS Rising, to provide funding to research or outreach projects that have the potential to transform global challenges into new opportunities that advance and promote Cartography and GIScience. Creativity, novelty, and the potential for broader impacts to society constituted key criteria for evaluating these proposals. In 2021–2022, CaGIS awarded three grants at approximately $10,000 each. In 2022–2023, one cross-institutional grant was awazrded.

- **UCGIS**

  The University Consortium for Geographic Information Science Awards Program identifies and honors members of our geospatial community who have extraordinary records of accomplishments, including service to the mission of UCGIS. UCGIS offers two research awards, the Research Award and the Early/Mid-Career Research Award. UCGIS offers two education awards, for Lifetime Achievement and for Innovation which alternate biennially. The society also offers the Carolyn Merry Mentoring Award and the UCGIS Service Award.

- **NACIS**

  The NACIS Student Scholarship in Cartography awards an annual scholarship to an accomplished undergraduate student who is majoring in geography or a closely related field while concentrating their course work in cartographic or visualization design or research. This award recognizes that, through the student's coursework, they will have demonstrated excellence in print or digital cartography, involvement in cartographic research, or activity in cartographic outreach. The NACIS Student Map and Poster Competition has two competition categories: cartographic design quality and cartographic research quality.

- **AAG CSG**

  One of the primary missions of the American Association of Geographers Cartography Specialty Group is to support student scholarship in cartography. The CSG sponsors or co-sponsors student awards and competitions to promote excellence in both cartographic research and excellence in map production. Awards include the Master's Thesis Research Grant, Cartographies of Change Paper Competition, Student Guided Poster Competition, Avenza Competition for Cartographic Design, and Travel Grants for Underrepresented Groups.

- **WAML**

  The goal of the WAML Scholarship program is to advance WAML's efforts toward being a more inclusive organization and to support the professional development of library-workers from diverse backgrounds. The WAML Distinguished Service Award in recognition of exemplary efforts toward the betterment of the Association.

A Note from the Editor

Cartography can be looked at from many angles. The ICA defines cartography as the discipline dealing with the art, science and technology of making and using maps. But I feel that cartography encompasses more than that. It involves any activity in which the map is the central intellectual unit. It includes the business of maps—production, printing, selling, and distribution. It involves research and teaching about maps. It also encompasses collecting, protecting, and archiving maps.

In this report, our goal was to cover this entire scope. Our contributors are certainly not the only ones involved in this in the United States, but they are representative of the many individuals, organizations, agencies, companies, programs, departments, and labs that contribute to our nation's cartographic advancements and achievements every day.

Please send comments / questions to abuckley@esri.com.

Contributor Profiles

These profiles provide information about the contributors to this report.

Non-profit Organizations and Associations

- AAG-CSG
- CaGIS
- IMIA
- NACIS
- UCGIS

Map Librarians

- Esri Library
- WAML

Academic Programs

- Penn State Geography
- Smithsonian Institution
- Texas A&M
- University of Oregon

University Labs

- Cart Lab – University of Wisconsin, Madison
- GAMLab –University of Colorado, Denver
- GeoGraphics Lab – Pennsylvania State University
- Infographics Lab – University of Oregon
- Western Illinois University GIS Center

Government Agencies

- Census Bureau
- NOAA Office of Coast Survey
- USGS CEGIS

Commercial Cartography

- Darren Sears
- Esri
- National Geographic Society
- Treeline Terrains

Compiled by the U.S. National Committee for the ICA, a standing committee of the Cartography and Geographic Information Society.

Spotlight:

National Geographic Society

This 1:1M map of Ukraine (shown below), included in the June 2023 issue of National Geographic magazine, continues the National Geographic Society's tradition of depicting conflict in Europe. It introduces a new map policy note for Southeastern Ukraine and illustrates National Geographic's *de facto* approach to cartographic depictions of territorial control. Delineations mark the estimated maximum extent of Russian advances, territorial claims, and the approximate frontline a calendar year after the full-scale invasion.

- **Name of Organization:** American Association of Geographers Cartography Specialty Group
  Acronym: AAG CSG
- **Mission Statement:** The mission of the Cartography Specialty Group is to encourage cartographic research and promote education in cartography and map use. To achieve this mission, we strive to facilitate the exchange of ideas and information about cartography; promote interest in and correct utilization of maps and other cartographic products; promote and facilitate the cartographer's role within the geographic profession; and promote and coordinate activities and directions with other professional organizations involved with cartography.
- **Members:** About 350 members
- **Website:** https://aagcartography.wordpress.com/
- **Contact:** Jack Swab, CSG President, jswab@uky.edu
- **Social Media:** Twitter: @cartoaag
- **Membership:** We are a specialty group of the Association of American Geographers (AAG). If you are an AAG member and are interested in joining the CSG, please visit our Membership Page. Dues are $2 for AAG student members and $6 AAG faculty/professional members.

Signature Events

Annual Meeting of the American Association of Geographers

The CSG helps organize and sponsor sessions about cartography in all of its facets at the AAG Annual Meeting. On occasion, the CSG also co-sponsors sessions with other specialty groups of the AAG. The Annual Meeting is also where the annual CSG business meeting occurs, however there are also virtual attendance options as well. In recent years, the Annual Meeting has been the location for our Illustrated Paper Competition and Competition in Cartographic Design. Students from underrepresented backgrounds are encouraged to apply for the CSG Travel Grants for Underrepresented Groups, which provide additional funding to support in-person attendance at the annual meeting.

Awards and Honors

One of the primary missions of the cartography specialty group is to support student scholarship in cartography. The Cartography Specialty Group (CSG) sponsors or co-sponsors several student awards and competitions to promote excellence in both cartographic research and excellence in map production. Click the links below for more information:

- Master's Thesis Research Grant
- Illustrated Paper Competition
- Competition in Cartographic Design
- Travel Grants for Underrepresented Groups

Master's Thesis Research Grant

This grant is intended to promote scholarly research in cartography by students enrolled in Geography or a related degree program. A maximum of two awards of $500 are presented annually. Winners are

selected from competitive applications to support the best research proposal at the Master's level in cartography. Deadlines for applications are March 15 and November 1 of each year.

Previous winners include:

- 2022: Bea Abbott, Department of Geography, University of Kentucky
- 2021: Lindsey Rotche, Department of Geography and Environmental Studies, University of New Mexico
- 2020: Yuhao Kang, Department of Geography, University of Wisconsin-Madison, advised by Song Gao
- 2019: Levi Westerveld, Department of Geography, University of Bergen (UiB), Norway and Jack Swab, Department of Geography, University of Kentucky

Travel Grants for Underrepresented Groups

Two awards of $250 are presented annually. Winners are selected from competitive applications to support the attendance and participation of traditionally underrepresented groups at the Annual Meeting of the AAG. More information can be found here:
https://aagcartography.wordpress.com/awards-competitions/

- **Name of Organization:** Cartography and Geographic Information Society
- **Acronym:** CaGIS
- **Mission Statement:** The mission of the Cartography and Geographic Information Society is to support research, education, and practice to improve the understanding, creation, analysis, and use of maps and geographic information to support effective decision-making and improve the quality of life. The Society serves as a forum for the exchange of original concepts, techniques, approaches, and experiences by those who design, implement, and use cartography, geographical information systems, and related geospatial technologies.
- **Members:** 187 Active Members as of June 27, 2023. Figure 1 shows the makeup of the Society's membership.

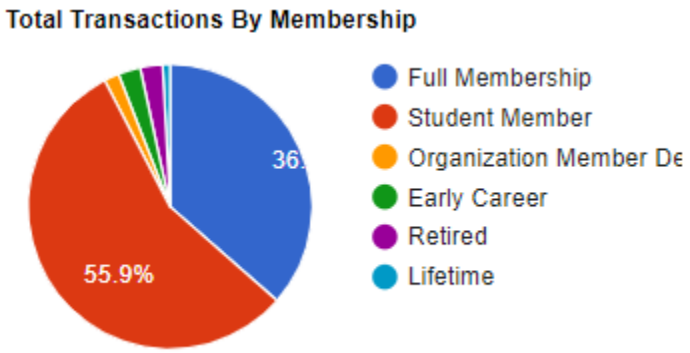


Figure 1. Composition of the CaGIS membership

- **Website:** https://cartogis.org/
- **Contact:** Kari J. Craun; Executive Director; cagisexecdir@gmail.com
- **Social Media:**
    - Facebook: https://www.facebook.com/CartographyGIS
    - LinkedIn: Cartography and Geographic Information Society group
    - Mapstodon: https://mapstodon.space/@CaGIS

Significant or Signature Events

AutoCarto 2022: Ethics in Mapping

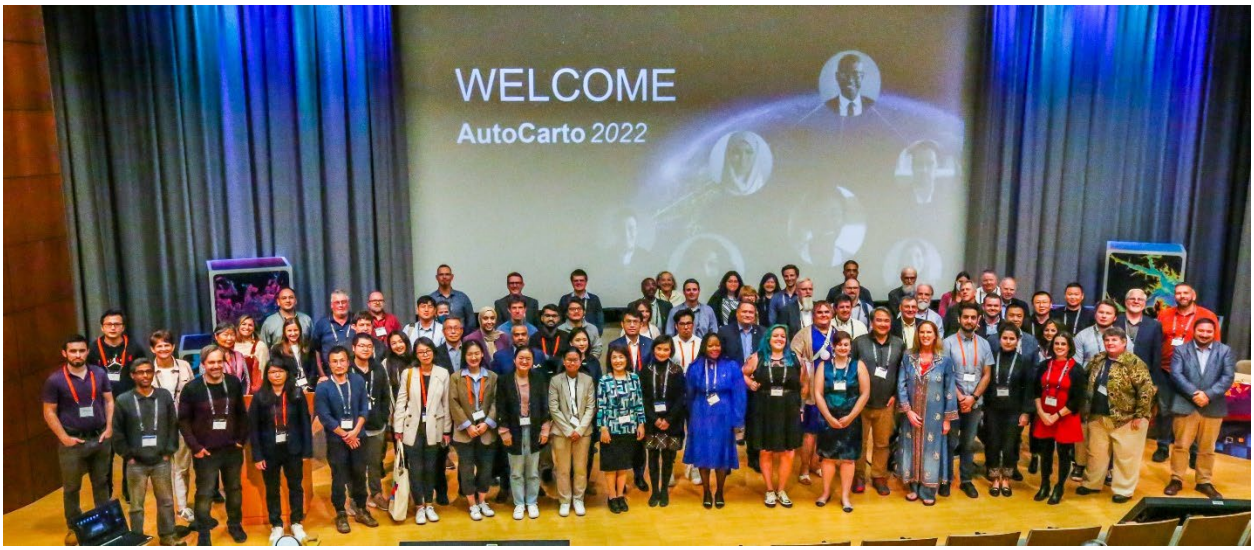


Figure 2. AutoCarto 2022 participants

In November 2022, CaGIS presented AutoCarto 2022, the 25th International Research Symposium on cartography and GIScience, with its focus on the intersection of the two. AutoCarto 2022 was a hybrid event for both in-person attendees and virtual participants. There were 184 registrants—112 attended in person and 72 were virtual participants (Figure 2). It was held Wednesday through Friday, November 2–4, with workshops on Tuesday, November 1, on the Esri campus in Redlands, California, USA.

The theme of AutoCarto 2022 was Ethics in Mapping: Integrity, Inclusion, and Empathy which brings attention to ethical responsibilities we face in all aspects of our discipline, with conversations on the power of maps and the critical need for integrity, inclusion, and empathy in cartography and GIScience.

AutoCarto 2022 was the first ICA Regional Cartographic Conference in the United States. ICA President, Tim Trainor, ICA Secretary-General, Thomas Schultz, and ICA Vice President, Terje Midtbø attended the conference. There was special session in memory of former ICA Vice President, Lynn Usery.

All of the talks, including the plenary sessions, were recorded, and the abstracts, slides and videos for each talk and the graphics for each poster are freely accessible on the AutoCarto 2022 website, https://cartogis.org/autocarto/autocarto-2022/program/presentations.

Publication

Cartography and Geographic Information Science

Cartography and Geographic Information Science (*CaGIS*) is the official publication of the Cartography and Geographic Information Society. The *CaGIS* journal is published six times per year by Taylor and Francis. The journal editor is Eric Delmelle, and the Associate Editors are Nicholas Chrisman, Frank Canters, and Ourania Kounadi. Nick Bearman is the Cartographic Editor. The journal may be accessed online via the Taylor and Francis website and members can access the journal online via the CaGIS website.

Awards and Honors

CaGIS provided a number of awards in 2023, including Map Design Competition Awards; Children's Map Competition Awards; Student Scholarships; and Student Assistant Scholarships to attend AutoCarto 2022. CaGIS also presented two Distinguished Career Awards.

CaGIS Map Design Competition

The 50th annual CaGIS Map Design Competition had 55 professional entries and 36 student entries. The Best of Show was awarded to the *Atlas of Yellowstone, 2nd ed.,* W. Andrew Marcus, James E. Meacham, Ann W. Rodman, Alethea Y. Steingisser, Justin T. Menke, and Ross West, University of Oregon and Yellowstone National Park (Figure 3). Other professional winners included Reference: *The Essential Geography of the Salish Sea* by Jeff Clark, Clark Geomatics; Recreation/Travel: *Big Bend National Park Day Hikes* by Jeremy Goldsmith and Christopher Knoll, National Geographic Staff; Thematic: *A Summit in the Deadliest Season* by Soren Walljasper, National Geographic Staff; Books/Atlases (tie): *Stargazer's Atlas: The Ultimate Guide to the Night Sky*, cartography by Debbie Gibbons and Greg Ugiansky, National Geographic Partners And *Atlas of Yellowstone, 2nd Ed.,* W. Andrew Marcus, James E. Meacham, Ann W. Rodman, Alethea Y. Steingisser, Justin T. Menke, and Ross West, University of Oregon and Yellowstone National Park; and Interactive/Animated: Resurfacing the past by Ross Donihue, Will Hackney, Cooper Thomas, Hannah Wilber: Esri; and Paul Heersink: Esri Canada. Student winners included the David Woodward Interactive/Animated Digital Map Award, *Mapping the Infrastructure of the Roman Empire by Sirius T. Bontea, University of Kentucky:* https://siriusbontea.github.io/roman-empire/**;** and the Arthur Robinson Static Print Map Award, *Visualizing Historical Hurricanes in Contiguous United States (1851 – 2021)* by Chenxiao (Atlas) Guo, University of Wisconsin – Madison (Figure 4).

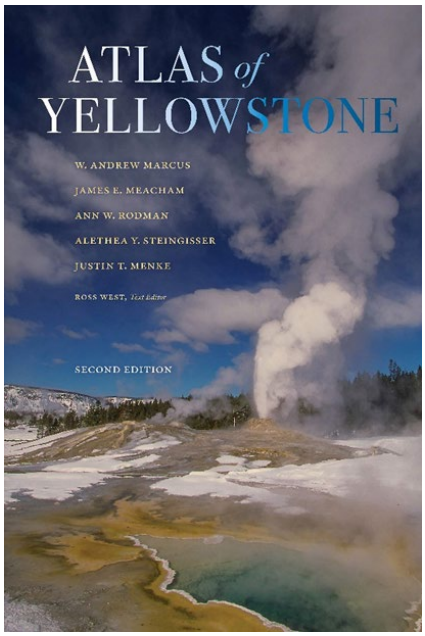


Figure 3. Best of Show

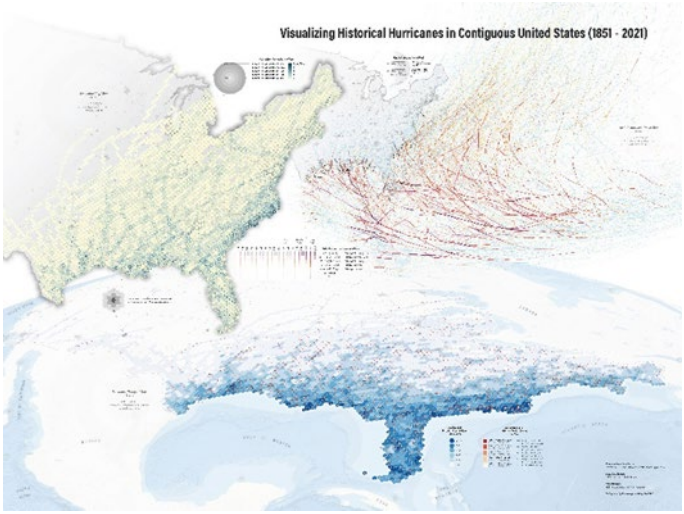


Figure 4. Arthur Robinson Static Print Map Award Winner

National Children's Map Competition

The Children's Map Competition is a U.S. national competition for all children ages 15 years or younger. The goal of the contest is to promote the creative representation of the world in graphic form by

children. It has been offered every two years to celebrate the creativity, imagination, artistry, and wisdom of child mapmakers. This year's theme was "A Map of My Future World!"

There were 42 entries for the 2023 competition. These were displayed at the Annual Meeting of the American Association of Geographers in Denver from March 24 – 26. Viewers were able to "vote" for their favorite maps using stickers. First, second, and third place winners were selected in four age categories: under 6 years old, 6 to 8 years old, 9 to 12 years old, and 13 to 15 years old. Two of the winning entries are shown below (Figures 5 and 6). Six entries are chosen as entries in the International Cartographic Association's Barbara Petchenik Children's World Map Drawing Competition.

Figure 5. Peace World
Addison Chrzanowski, Age 8

Figure 6. New and Improved
Crosby Price & Isabella Wilfling, Age 14

CaGIS Scholarships

CaGIS scholarships recognize academic achievement and encourage the continuing success of outstanding cartography and geographic information science students. The scholarships also recognize achievement or potential for achievement in original research advancing the specific disciplines of cartography or geographic information science. CaGIS was proud to award five scholarships this year! Ph.D. level scholarships were for 1500 USD, and master's level winners received 1000 USD.

The 2023 winners were:

- Ph.D. Yuhao Kang (University of Wisconsin-Madison), Advisor: Song Gao
- Ph.D. Jinwen Xu (University of South Florida), Advisor: Yi Qiang
- Ph.D. Yue Lin (The Ohio State University), Advisor: Ningchuan Xiao
- Master's Barira Rashid (Arizona State University), Advisor: Stephanie Deitrick
- Master's Oladunni Farinloye (Western Illinois University), Advisor: Christopher Sutton

Student Assistant Scholarships for AutoCarto 2022

CaGIS provided funding for ten students to attend and assist with AutoCarto 2022. These scholarships enabled students to attend the conference, network with other attendees, and gain experience working on an event.

Students receiving travel/assistant scholarships were:

- Yue Lin, The Ohio State University
- Debayan Mandal, Texas A&M University
- Jake Kruse, University of Wisconsin-Madison
- Binbin Lin, Texas A&M University

- Yuhao Kang, University of Wisconsin-Madison
- Hoeyun Kwon, University of Iowa
- Amir Forati, University of Wisconsin-Milwaukee
- Yu Lan, University of North Carolina-Charlotte
- Jinwen Xu, University of South Florida
- Bing Zhou, Texas A&M University

CaGIS Distinguished Career Award

In 2022–2023, CaGIS announced two Distinguished Career Awards. This award honors the accomplishments of senior professionals who have contributed substantially to the advancements of the fields of cartography, GIS or GIScience, or the interface between cartography and GIScience.

The 2022 award was given to Dr. Alan MacEachren from The Pennsylvania State University (Figure 7). Dr. MacEachren's innovative contributions to cartography and GIScience have spanned decades, as his early research in geographic representation and geovisualization coincided with the rise of scientific visualization. Since the 1980s, he has helped guide the national and international development of geographic visualization within cartography and GIScience to its current form as geovisual analytics, defined as the science of analytical reasoning facilitated by interactive geovisual interfaces. Dr. MacEachren's book *How Maps Work*, published in 1995, formalized and refined a cognitive-semiotic basis for geographic visualization in cartography, providing a guiding theoretical foundation for cartography at the same time that the discipline and profession were transitioning to interactive, online, and mobile media.

The 2023 Distinguished Career Award was given to Dr. Barbara (Babs) Buttenfield, University of Colorado (Figure 8). Dr. Buttenfield has had a long-standing focus on data generalizing and modeling, and she has made significant contributions to multi-scale mapping and database design, perhaps most notably through her continuing Research Faculty affiliation with the U.S. Geological Society's Center for Excellence in Geospatial Information Science. Dr. Buttenfield's diverse interests also include terrain modeling, dasymetric modeling, representations of uncertainly, error/accuracy assessment of spatial data, and graphical interface design and usability and evaluation, among other topics of relevance in cartography and GIScience. She has authored hundreds of publications in a variety of outlets; given and been invited to give presentations nationwide and internationally; won numerous awards for both her research and teaching; been an investigator on research grants earning millions of dollars; served as the lead and member on numerous national and institutional committees; and mentored scores of students, many of whom went on to hold prominent positions in academic, government, and the private sector.

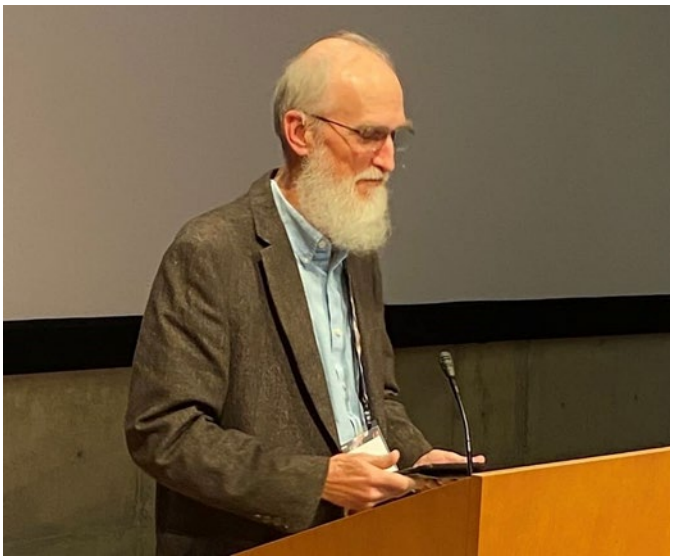


Figure 7. Alan MacEachren, receiving the 2022 CaGIS Distinguished Career Award at the AutoCarto 2022 Conference

Figure 8. Samantha Arundel presenting Babs Buttenfield with the CaGIS Distinguished Career award at the 2023 AAG Conference

Other Significant Programs/Projects

CaGIS Rising Grants

In 2021, CaGIS initiated a new grant program, CaGIS Rising, to provide funding to research or outreach projects that have the potential to transform global challenges into new opportunities that advance and promote Cartography and GIScience. Creativity, novelty, and the potential for broader impacts to society constituted key criteria for evaluating these proposals.

In 2021–2022, CaGIS awarded three grants at approximately $10,000 each. Projects receiving funding included the following:

1. Remastering Natural Earth with Neural Networks – Bridget Walker, Dilpreet Singh, and Bernhard Jenny, Monash University; Tom Patterson, U.S. National Park Service
2. Modeling and Visualizing the Extents of Historical Regions – Ivan Majic, Rizwan Bulbul, and Johannes Scholz, Graz University of Technology; Karl Grossner, University of Pittsburgh; and Eric Delmelle, University of North Carolina at Charlotte
3. Change in U.S. Contrail Outbreaks Before and During the COVID-19 Pandemic – Eun-Kyeong Kim, University of Zurich

In 2022–2023, a CaGIS Rising Grant was awarded to the project “Characterizing and Promoting Cartography and GIS Graduate Programs through Research Theme Discovery and Online Seminars.” Students involved in the project are Yuhao Kang (University of Wisconsin – Madison), Yanbing Chen (McGill University), Bing Zhou (Texas A&M University), and Zhining Gu (Arizona State University). Advisors are Song Gao (University of Wisconsin – Madison), Lei Zou (Texas A&M University), and Wenwen Li (Arizona State University).

- **Name of Organization:** International Map Industry Association
- **Acronym:** IMIA
- **Mission Statement:** The International Map Industry Association (IMIA) is dedicated to fostering the growth of the mapping industry through the exchange of ideas and information, the education of industry trends and technologies, and access to a wide spectrum of mapping leaders. Our global organization, based in the United States with board members from around the world, is one collective group with one voice advocating for the growth and success of the international mapping industry. Connecting the business of maps worldwide is our number one priority.
- **Members:** 50+ member companies
- **Website:** www.imiamaps.org
- **Contact:** Donna De Marco, Association Manager, imia@oferrallgroup.com
- **Social Media:** Facebook/Twitter/Instagram/LinkedIn: imiamaps

Significant or Signature Events

Mapping Leaders Forum

In keeping with IMIA's goals of advancing education and business networking, this annual in-person event combines interesting presentations with panel discussions and networking breaks, allowing attendees to meet new members and catch up with industry colleagues (Figure 1). The first day of the event, called Partner Day, focuses on the advantages of industry partnerships in changing marketplaces. The second day includes informative presentations and engaging panel discussions with leaders in the mapping and GIS industries. Forum topics have included: Geoethics, Diversity, Geospatial Data Management, New Product Releases, Digital & Print Map Publishing, E-Commerce Applications, Cybersecurity, and Geo-AI.

- Held annually in June
- Denver, Colorado, USA
- The venue varies by year. The venue in 2023 was the Wright Room in downtown Denver.
- In-person event
- https://imiamaps.org/mapping-leaders-forum-2023/
- 40 attendees

Publications

Hello Mappers!

This e-newsletter is released bi-monthly and includes member profiles, industry news, and events. https://imiamaps.org/imianews/

Figure 1. Executives from around the world gathered at the IMIA's annual Mapping Leaders Forum in Denver this past June to discuss and collaborate on a variety of topics affecting our industry.

Awards

Lifetime Achievement Award

This award is given in recognition of significant contributions to furthering IMIA over an extended period of time (at least 10 years). This could include contributions made as an IMIA Officer, board member, committee member, and/or association member. Applicants are voted on by the IMIA Board of Directors. Recent recipients of the award include:

- Barbara Peterson and Tom Rohr, Magna Carta Maps (2022)
- Dan Ortiz, National Geographic Maps (2023)

Clark Swinehart Leadership Award

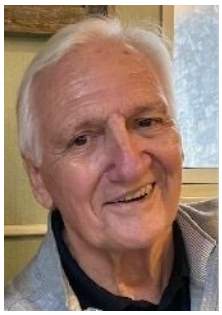
This award is given in recognition of significant contributions to the leadership of IMIA over an extended period of time (at least 10 years). It is named in honor of former IMIA supporter Clark Swinehart, Esri. Applicants are voted on by the IMIA Board of Directors. Recent recipients of award include:

- Clark Swinehart, Esri (2022, posthumous)
- Hans-Joachim Niemeyer, INTERKART, (2023)

Other Significant Initiatives

In 2021, IMIA began a formal program to partner with complementary affiliate organizations to raise awareness, promote the value of membership, and drive attendance and participation at events of both organizations. To that end, IMIA has successfully partnered with the following organizations: British Cartographic Society (BCS), International Cartographic Association (ICA), Cartography and Geographic Information Society (CaGIS), and Open Geospatial Consortium (OGC). In March 2023, IMIA hosted a multi-affiliate partner virtual event with BCS, CaGIS, and ICA.

In Memorium



International Map Industry Association Former Executive Director Sandy Hill passed away on Nov. 15, 2022. Sandy and his wife Linda managed the operations and conferences for the "Americas" division of organization for more than 15 years. Their support and efforts were the backbone of our organization through Sandy's retirement in 2016.

Link to Sandy's obituary: https://lancasteronline.com/obituaries/sanford-john-hill/article_c4dcfa1b-a446-5408-9cf2-04c04c9f34ff.html

- **Name:** North American Cartographic Information Society
- **Acronym:** NACIS
- **Society objectives:**
    - To improve communication, coordination and cooperation among the producers, disseminators, curators, and users of cartographic information
    - To support and coordinate activities with other professional organizations and institutions involved with cartographic information
    - To improve the use of cartographic materials through education and to promote graphicacy
    - To promote and coordinate the acquisition, preservation, and automated retrieval of all types of cartographic material, and
    - To influence government policy on cartographic information
- **Members:**
    - 384 Regular members
    - 118 Student members
    - 18 Affiliate members
- **Website:** https://nacis.org
- **Contact:** Patrick Kennelly, Past president, pastprez@nacis.org
- **Social Media:** Twitter: @NACIS

Significant or Signature Events

- Annual NACIS Conference
- Recurring annually
- Latest event:
    - October 19 – 21, 2022
    - Minneapolis, Minnesota
    - The Depot Minneapolis
    - In-person meeting
    - Program: https://nacis2022.sched.com
    - Recorded presentations: https://www.youtube.com/playlist?list=PLcBEhOBZvhcbTn1RC0zWbnuHA81SgIg8b
    - Attendees:
        - 253 for Practical Cartography Day
        - 353 for the main NACIS Conference
        - https://youtu.be/e4UJD-Mo3l8 (Courtesy of Benzek Design https://www.benzekdesign.com)

Publications

Journal

- *Cartographic Perspectives*
- Three issues annually

- https://cartographicperspectives.org

Atlas

- *Atlas of Design*
- Six volumes, published biennially
- https://atlasofdesign.org
- Volume 6 was published October of 2022, 100 pages, featuring 32 maps from around the world. Submissions for Volume 7 will open in October 2023, and the volume will be published in 2024. After reprints carried out in early 2023, all six volumes are now in print.

Awards and Honors

Corlis Benefideo Award

- This award recognizes imaginative cartography. Cartography is often seen by the public as work opposed to imagination, grounded entirely in established fact. While this devotion to reflecting what is forms the heart of cartographic thinking, cartographers and artists who use maps as a basis for their work can (and do) take that grounding in fact and use it to venture into the world of the possible. Some explore real places from perspectives that allow us to see it fresh and full of possibility, and some take our established traditions of mapmaking, and indeed take fully constructed maps themselves, and turn them on their heads to make us see ourselves anew.
- https://nacis.org/awards/corlis-benefideo-award/
- The next round of nominations is open now. Three recipients have been awarded since 2013. The Award is named after the fictional cartographer in Barry Lopez's short story "The Mappist." Lopez died in 2020.

Undergraduate Student Scholarship in Cartography

- The NACIS Student Scholarship in Cartography awards an annual scholarship to an accomplished undergraduate student who is majoring in geography or a closely related field while concentrating their course work in cartographic or visualization design or research. This award recognizes that, through the student's coursework, they will have demonstrated excellence in print or digital cartography, involvement in cartographic research, or activity in cartographic outreach.
- https://nacis.org/awards/undergraduate-student-scholarship-in-cartography/

Cartographic Perspectives Student Peer-Reviewed Paper Competition

- Students can win an award of $1,350 by contributing peer-reviewed articles to *Cartographic Perspectives (CP)*. Any peer-reviewed manuscript accepted for publication in the calendar year whose first author is a student is automatically entered into the Student Peer-Reviewed Paper Competition, which is judged annually by a panel composed from the Editorial Board of *CP*.
- https://cartographicperspectives.org/index.php/journal/article/view/1697/1971

Student Dynamic Map Competition

- NACIS recognizes the importance of digital and dynamic mapping in cartography. By sponsoring the Student Dynamic Map Competition, NACIS promotes excellence and

innovation in interactive cartography. There are two competition categories: individual projects and group projects.

- https://nacis.org/awards/student-dynamic-map-competition/

Student Map and Poster Competition

- Students who would like to display their work at the annual NACIS conference should register for the Student Map and Poster Competition. We encourage all students to submit their maps and cartography-related technical or research posters for a chance at one of two $500 prizes! There are two competition categories: cartographic design quality and cartographic research quality. There is no entry fee. All entrants will be displayed in the Map Gallery and the winners will be selected by a ballot of all meeting attendees.
- https://nacis.org/awards/student-map-and-poster-competition/

Other Significant Initiatives

- Natural Earth data - https://www.naturalearthdata.com
- NACIS Mentor Program - https://nacis.org/initiatives/nacis-mentor-program/
- NACIS Shop - https://nacis.org/initiatives/nacis-apparel/

University Consortium for
GEOGRAPHIC INFORMATION SCIENCE

- **Name of Organization:** University Consortium for Geographic Information Science
- **Acronym or Short Name:** UCGIS
- **Mission Statement:** The University Consortium for Geographic Information Science (UCGIS) is a non-profit organization that creates and supports communities of practice for GIScience research, education, and policy endeavors in higher education and with allied institutions. We are the professional hub for the academic GIS community in the United States, with partnerships extending this capacity abroad.
- **Members:** 60+ member and affiliate institutions
- **Website:** www.ucgis.org
- **Contact:** Amy Rock, Executive Director, arock@ucgis.org
- **Social Media:**
    - X (SFKA) Twitter: @UCGIScience
    - LinkedIn: linkedin.com/company/ucgis
    - Slack: tinyurl.com/trsbdcyy

Description

UCGIS is a scientific and educational organization comprised of 60+ members and affiliate institutions. Our annual Symposium brings together researchers, educators, and industry professionals to advance and strengthen research and education, and advocate for the promotion of the ethical use of and access to geographic information and technologies.

Significant or Signature Events

UCGIS Symposium

- **Short Description:** Annual symposium open to all
- **Date:** June 6-9, 2023
- **Location:** Yale University, New Haven, CT
- **Format:** In person, comprised of panel and roundtable discussions, paper and poster sessions, and workshops
- **Website:** https://ucgis.memberclicks.net/symposium-2023
- **Attendees:** approximately 120

Publications

GIS&T Body of Knowledge

- **Short Description:** This Body of Knowledge documents the domain of geographic information science and its associated technologies (GIS&T). By providing this content in a new digital format, UCGIS aims to continue supporting the GIS&T higher education community and its connections with the practitioners.
- **Date of Publication or Release Cycle:** Continuous
- **Website:** https://gistbok.ucgis.org/

Awards

The following awards were conferred at the 2023 Symposium:

- UCGIS Research Award: Nina Lam
- Early/Mid-Career Research Award: Chunyuan Diao
- Lifetime Achievement in GIScience: Michael DeMers
- Carolyn Merry Mentoring Award: Alan Murray
- UCGIS Fellows, Class of 2023: May Yuan, Kathleen Stewart, and Wenwen Li

Other Significant Initiatives

UCGIS is a partner in the ongoing I-GUIDE project at the University of Illinois Urbana-Champaign, which involves leveraging spatial data and data visualization to develop sustainable, holistic solutions.

We are also pleased to be a part of the GLOW initiative in collaboration with the University of Chicago Library. The project—GIS Librarians for Open Workflows (GLOW)—focuses on the workflows of librarians and library staff charged with supporting geographic information systems (GIS) and its use across diverse academic disciplines. The $133,992 grant supports multiple in-person forums and workshops, as well as the coordination of existing and new open educational resources.

Our flagship program, the GIS&T Body of Knowledge, continues to be a substantial open-access resource for GIS and associated technologies (Figure 1). In summer 2023, the BoK is undergoing a platform overhaul that will include a visual search interface, deeper integration of topics, and tools for curriculum development, content connection to CVs and job descriptions, and more. We look forward to rolling out the new interface sometime in the fall of 2023.

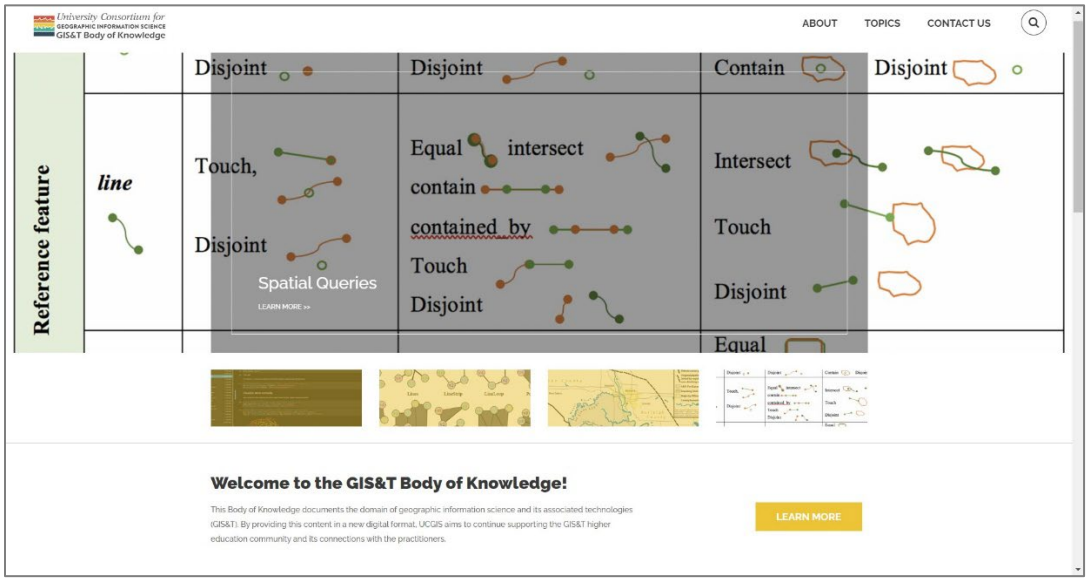


Figure 1. The GIS&T Body of Knowledge home page.

- **Name:** Esri Library
- **Mission Statement:** The Esri Library collects, organizes and distributes information about GIS and related fields. The mission of the library is to provide relevant and timely information that supports Esri employees and advances the business goals of Esri.
- **Staff:** 1 Corporate Librarian
- **Website:** https://gis.library.esri.com/
- **Contact:** Colleen Conner, Corporate Librarian, cconner@esri.com
- **Social Media:** X (SFKA Twitter): @esripress

Description

The Esri Library serves as a research destination for Esri employees working on software development, educational training and industry applications of GIS. The Esri Library is also committed to contributing GIS information to educators, students and the GIS community, through the publicly accessible Esri GIS Bibliography.

Other Significant Initiatives or Information

The Esri Library collection moved to a new home in 2021, a newly renovated space that served as the first building on the Esri Campus. The new library features five conference rooms, several collaborative spaces as well as a larger footprint for the library collection.

Figure 1 The Esri Library is utilized by Esri employees seeking access to quick reference materials or for larger research projects.

Figure 2. The Esri Library collection has grown to over 100,000 items, including print and electronic materials.

- **Name of Organization:** Western Association of Map Libraries
- **Acronym or Short Name:** WAML
- **Mission Statement:** The Western Association of Map Libraries (WAML) is an independent association of map librarians and other people interested in advancing geospatial excellence in libraries of western North America and beyond.
- **Members:** 77 members. 63 regular members, 3 student members, and 11 lifetime members
- **Website:** https://waml.org/
- **Contact:** Katherine Strickland, Maps Coordinator, the University of Texas at Austin, UT Libraries, strickland@austin.utexas.edu
- **Social Media:** X (SFKA Twitter): @wamlrobot | Facebook | Flickr

Description

Membership in WAML is open to any individual interested in furthering the purpose of the Association, which includes:

- Providing a welcoming and inclusive space where professionals and enthusiasts alike can learn, share, thrive, and build expertise;
- Advocating for access to and preservation of geospatial data and collections;
- Energizing our members through networking, mentoring, collaboration, and continuing education; and
- Developing and disseminating professional standards and best practices that advance our field.

Significant or Signature Events

2023 WAML Annual Conference

The WAML conference provides a great opportunity for students or new/transitioning librarians to learn, network, and develop themselves and the profession of Map and GIS librarianship.

- **Next Event:** 2023 WAML Conference
- **Date:** Wednesday, August 9th through Saturday, August 12th, 2023
- **Location:** University of British Columbia, Vancouver, Canada
- **Format:** Hybrid meeting; In-person with a limited version of the conference live-streamed on Thursday and Friday for virtual audiences.
- **Website:** https://waml.org/conferences/waml-2023/
- **Attendees:** 41 in-person; 33 virtual

Publications

The Western Association of Map Libraries Information Bulletin (IB), Journal

The Information Bulletin (IB) is the official journal of the Western Association of Map Libraries. It is an open access journal issued three times each year. Issue number 1 is released in November, Issue

number 2 in March, and Issue number 3 in July. The IB encourages high standards in every phase of the organization and administration of map and geospatial data libraries.

Awards

WAML Distinguished Service Award

The WAML Distinguished Service Award in recognition of exemplary efforts toward the betterment of the Association. Recent recipient, Ken Rockwell, received the award in 2019.

WAML Scholarship

The overarching goal of the WAML Scholarship program is to advance WAML's efforts toward being a more inclusive organization and to support the professional development of library-workers from diverse backgrounds. There are two primary objectives:

1. Provide an opportunity for library-workers from under-represented racial, social, and/or class groups who are interested in map and geospatial librarianship to learn more about the profession, meet colleagues, and add new skills and knowledge.
2. Introduce new or transitioning library-workers to the world of map librarianship and the emerging career of GIS (Geographical Information Systems) librarianship.

As an organization we believe that it is critical for our profession to reflect on and engage with the cultural and structural biases that are inherent to map and geospatial librarianship, and thus are actively recruiting people who may contribute new perspectives and experiences.

The 2023 WAML Scholarship Winners will be announced at the WAML Annual Conference later in August 2023.

In Memoriam

Stanley D. Stevens (1933-2022)

Stan Stevens was a charter member of WAML. He was map librarian emeritus at University of California Santa Cruz. He passed away on October 25, 2022. Stan was 88 years old.

Phil Hoehn (1941-2023)

Phil Hoehn was a longtime UC Berkeley Maps and Earth Sciences Librarian and an early member of the Western Association of Map Libraries (WAML), having joined in 1969, just two years after the organization was founded. He passed away on February 6, 2023, at the age of 81.

PennState
College of Earth and Mineral Sciences
Department of Geography

- **Name of Department:** The Pennsylvania State University Department of Geography
- **Acronym:** Penn State Geography or PSU Geography
- **Mission Statement:** The Department of Geography at Penn State is committed to building a resilient and just world by bridging the subfields of geography to identify innovative and creative social, environmental, and spatial solutions. We seek these solutions through our teaching, research, and service by advancing the vision of how to sustain landscapes and livelihoods, respond to the climate crisis, and make data science spatial. We see these as grand challenges for Penn State Geography.
- **Staff:** 116 total, 45 of whom are affiliated with the GISciences subfield, and of those, nine focus specifically on cartography: Cynthia Brewer (faculty); Harrison Cole (postdoc); Nikolay Golosov (graduate student); Lily Houtman (graduate student); Fritz Kessler (faculty); Belen Norona (faculty); Tim Prestby (graduate student); Anthony Robinson (faculty); Marcela Suarez (faculty).
- **Website:** https://www.geog.psu.edu/
- **Contact:** geography@psu.edu

Significant or Signature Events

ICC 2023 Pre-Conference Workshop on Cartography and AI (MapAI)

- Organized by ICA Commission on Visual Analytics, Anthony Robinson, Co-chair
- Recurring event? No
- August 12, 2023
- Stellenbosch, South Africa
- Department of Geography and Environmental Studies, Stellenbosch University
- In-person meeting
- https://viz.icaci.org/call-for-presentations-icc-2023-pre-conference-workshop-on-cartography-and-ai-mapai/
- 50 attendees

Publications

Anthony Robinson

- Anderson, C. L., & Robinson, A. C. (2021). Affective Congruence in Visualization Design: Influences on Reading Categorical Maps. *IEEE Transactions on Visualization and Computer Graphics*.
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Harrison Cole

- Cole, H. (2021a). Tactile cartography in the digital age: A review and research agenda. *Progress in Human Geography*, *45*(4), 834–854. https://doi.org/10.1177/0309132521995877
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Awards and Honors

Anthony Robinson

- 2023 Penn State College of Earth and Mineral Sciences Wilson Award for Excellence in Teaching. This award is given in recognition of outstanding teaching represented by performance in a single course of instruction or a series of contributions around a coherent theme. The contribution may represent application of knowledge in a traditional classroom setting, field course, or online education. https://www.ems.psu.edu/research-faculty/about-our-faculty/faculty-honors-and-awards/awards-excellence/wilson-award

Tim Prestby

- 2022 Graduate Research Fellowship, National Science Foundation. With over 12,000 submissions, roughly 2,000 awards are given out. The program recognizes and supports outstanding graduate students who are pursuing full-time research-based master's and doctoral degrees in science, technology, engineering, and mathematics (STEM) or in STEM education. The GRFP provides three years of support over a five-year fellowship period for the graduate education of individuals who have demonstrated their potential for significant research achievements in STEM or STEM education. https://www.research.gov/grfp/AwardeeList.do;jsessionid=225BFB1DFD9D2205366717C6D53BC02A

Alan MacEachren

- 2021 Carl Mannerfelt Gold Medal of the International Cartographic Association (ICA). The ICA Carl Mannerfelt Gold Medal is awarded to cartographers of outstanding merit who have made significant contributions of an original nature to the field of cartography. It is awarded only on rare occasions in order to emphasize its distinction. https://www.youtube.com/watch?v=_cKxunoZjDk.
- 2022 Cartography and Geographic Information Science (CaGIS) Distinguished Career Award. The CaGIS Distinguished Career Award honors the accomplishments of senior professionals who have contributed substantially to the advancements of the fields of cartography, GIS or GIScience, or the interface between cartography and GIScience. https://cartogis.org/awards/career/

Cynthia Brewer

- 2019 O. M. Miller Cartographic Medal of the American Geographical Society (AGS). This medal recognizes outstanding contributions in the field of cartography or geodesy. It was awarded to Dr. Brewer at the AGS Geography 2050 Symposium at Columbia University in New York City. https://www.directionsmag.com/pressrelease/9287

Smithsonian Institution

- **Name of institution:** Smithsonian Institution
- **Acronyms:** SI
- **Mission statement:** The mission of the Smithsonian is to increase and diffuse knowledge. The Smithsonian builds on its unique strengths to engage and to inspire more people, where they are, with greater impact, while catalyzing critical conversation on issues affecting our nation and the world.
- **Number of Staff Members:** Over 6000
- **Website:** https://www.si.edu/. For more about the SI collections, see https://storymaps.arcgis.com/collections/c71da2f4cfa443c8b1129d6f7adbfcb0?item=1.
- **Contact information:** Daniel G. Cole, GIS Coordinator, coled@si.edu

Description

The Smithsonian Institution includes 21 museums, the National Zoo, and eight research centers which are located in Washington, DC; New York City; Panama; Front Royal, VA; Edgewater, MD; Cambridge, MA; Fort Pierce, FL; Suitland, MD. The SI also includes many research programs.

The 21 museums include the National Museum of Natural History, Smithsonian American Art Museum, National Museum of African American History and Culture, Anacostia Community Museum, National Museum of the American Indian, National Air & Space Museum, Smithsonian Astronomical Observatory, Smithsonian Tropical Research Institute, National Zoological Park, Smithsonian Conservation Biology Institute, Smithsonian Environmental Research Center, Smithsonian Gardens, National Postal Museum, National Portrait Gallery, Cooper-Hewitt Smithsonian Design Museum, Center for Folklife and Cultural Heritage, Freer and Sackler Galleries, Hirshhorn Museum and Sculpture Garden, Museum Conservation Institute, National Museum of African Art, National Museum of American History, and Smithsonian Facilities.

At the Smithsonian, we have over 500 geospatial software users between an overlap of GIS, Story Maps, Cartographic and Remote Sensing packages creating, analyzing, producing, and publishing spatial data. A list of recent publications is provided below.

Significant or Signature Events

Smithsonian Folklife Festival

- Annual event
- Late June to early July
- The National Mall, Washington, DC
- Online and in-person
- https://festival.si.edu/
- Many thousands of visitors

Recent Publications

Bardou, R., J.D. Parker, I.C. Feller, and K.C. Cavanaugh. (2020) Variability in the fundamental versus realized niches of North American mangroves. *Journal of Biogeography* 48:160-175 https://doi.org/10.1111/jbi.13990.

Hensel M.J.S., C.J. Patrick, R.J. Orth, et al. (2023) Rise of Ruppia in Chesapeake Bay: Climate change-driven turnover of foundation species creates new threats and management opportunities. *Proc Natl Acad Sci USA* 120(23):e2220678120. https://doi.org/10.1073/pnas.2220678120.

Holmquist, J.R., L.N. Brown, and G.M. MacDonald. (2021). Localized Scenarios and Latitudinal Patterns of Vertical and Lateral Resilience of Tidal Marshes to Sea-Level Rise in the Contiguous United States. *Earth's Future*, e2020EF001804. https://doi.org/10.1029/2020EF001804.

Holmquist, J.R., L. Schile-Beers, K. Buffington, M. Lu, T.J. Mozdzer, J. Riera, D.E. Weller, M., Williams, and J.P. Megonigal. (2021). Scalability and performance tradeoffs in quantifying relationships between elevation and tidal wetland plant communities. *Marine Ecology Progress Series*, 666, 57-72. https://doi.org/10.3354/meps13683.

Holmquist, J.R. and L. Windham-Myers. (2022). A Conterminous USA-Scale Map of Relative Tidal Marsh Elevation. *Estuaries and Coasts*. https://doi.org/10.1007/s12237-021-01027-9.

Hood R.R., G.W. Shenk, R.L. Dixon, et al. (2021) The Chesapeake Bay Program Modeling System: Overview and Recommendations for Future Development. *Ecological Modelling* 465:1-109635 https://doi.org/10.1016/j.ecolmodel.2021.109635.

King, R.A, J. Pullen, S.C. Cook-Patton, and J.D. Parker (2023) Diversity stabilizes but does not increase sapling survival in a tree diversity experiment. *Ecology* 31: e13927 https://doi.org/10.1111/rec.13927.

Ogburn M.B., L.V. Plough, W. Charles, C.B. Bangley, et al. (2022) Environmental DNA reveals anadromous river herring habitat use and recolonization after restoration of aquatic connectivity. Environmental DNA 00:1–13 https://doi.org/10.1002/edn3.348.

Orth R.J., W.C. Dennison, D.J. Wilcox, et al. (2022) Data synthesis for environmental management: A case study of Chesapeake Bay. *Journal of Environmental Management* 321:115901 https://doi.org/10.1016/j.jenvman.2022.115901.

Weller D.E., M.E. Baker, and R.S. King (2023) New methods for quantifying the effects of catchment spatial patterns on aquatic responses. *Landscape Ecology* https://doi.org/10.1007/s10980-023-01706-x.

Weller D.L., T.M.T. Love, D.E. Weller, C.M. Murphy, B.G. Rahm, and M. Wiedmann (2022) Structural Equation Models Suggest that On-Farm Noncrop Vegetation Removal is Not Associated with Improved Food Safety Outcomes but is Linked to Impaired Water Quality. *Appl. Environ. Microbiol*. 88(23):e0160022 https://doi.org/10.1128/aem.01600-22.

Smithsonian Conservation Biology Institute

Brown, M. B., J.T. Fennessy, R.D. Crego, C.H. Fleming, J. Alves, K., Brandlová, … and J. Stabach. (2023). Ranging behaviours across ecological and anthropogenic disturbance gradients: a pan-African perspective of giraffe (Giraffa spp.) space use. *Proceedings of the Royal Society B*, 290(2001), 20230912. https://doi.org/10.1098/rspb.2023.0912.

Crego, R.D., H.B. Wells, K.S. Ndung'u, L. Evans, R. Njeri Nduguta, M.A. Chege, … and J.A. Stabach. (2021). Moving through the mosaic: identifying critical linkage zones for large herbivores across a multiple-use African landscape. *Landscape Ecology*, 36, 1325-1340. https://doi.org/10.1007/s10980-021-01232-8.

Fergus, C., I.L. Lacher, V. Herrmann, W.J. McShea, and T.S. Akre. (2023). Predicting vulnerability of forest patches to invasion by non-native plants for landscape scale management. *Ecological Application*s, e2857. https://doi.org/10.1002/eap.2857.

Huang, Q., B.L. Bateman, N.L. Michel, A.M. Pidgeon, V.C. Radeloff, P. Heglund, … and J.R. Sauer. (2023). Modeled distribution shifts of North American birds over four decades based on suitable climate alone do not predict observed shifts. *Science of the Total Environment*, 857, 159603. https://doi.org/10.2139/ssrn.4016133.

Lacher, I., C. Fergus, W.J. McShea, J. Plisinski, L. Morreale, and T.S. Akre. (2023). Modeling alternative future scenarios for direct application in land use and conservation planning. *Conservation Science and Practice*, e12940. https://doi.org/10.1111/csp2.12940.

Majaliwa, M.M., L.F. Hughey, J.A. Stabach, M. Songer, K. Whyle, A.E.A. Alhashmi, … and K. Mertes. (2022). Experience and social factors influence movement and habitat selection in scimitar-horned oryx (Oryx dammah) reintroduced into Chad. *Movement Ecology*, 10(1), 1-13. https://doi.org/10.1186/s40462-022-00348-z.

de Silva, S., T. Wu, P. Nyhus, A. Weaver, A. Thieme, J. Johnson, J., ... and P. Leimgruber. (2023). Land-use change is associated with multi-century loss of elephant ecosystems in Asia. *Scientific Reports*, 13(1), 5996. https://doi.org/10.1038/s41598-023-30650-8.

Stabach, J.A., L.F. Hughey, R.D. Crego, C.H. Fleming, J.G.C. Hopcraft, P. Leimgruber, ... and R. Boone, R. B. (2022). Increasing anthropogenic disturbance restricts wildebeest movement across East African grazing systems. *Frontiers in Ecology and Evolution*, 10. https://doi.org/10.3389/fevo.2022.846171.

Yang, H., A. Viña, J.A. Winkler, M.G. Chung, Q. Huang, Y. Dou, ... and J. Liu. (2021). A global assessment of the impact of individual protected areas on preventing forest loss. *Science of the Total Environment*, 777, 145995. https://doi.org/10.1016/j.scitotenv.2021.145995.

National Museum of Natural History

Cole, Daniel G., and E. Richard Hart (2021). The Importance of Indigenous Cartography and Toponymy to Historical Land Tenure and Contributions to Euro/American/Canadian Cartography, *International Journal of Geo-Information*, 10 (6): 397-410. Open access online at https://www.mdpi.com/2220-9964/10/6/397; https://doi.org/10.3390/ijgi10060397.

- **Lab Name:** Geospatial Exploration and Resolution Lab at the Department of Geography, Texas A&M University (TAMU)
- **Acronym:** GEAR Lab
- **Mission Statement:** GEAR Lab's mission is to build a healthy, resilient, and sustainable future for human communities amidst changing climates and environments through spatial and responsible thinking, novel data, and intelligent algorithms. We aim to explore diverse geospatial data and analysis methods, advance GIScience theories and algorithms, and resolve real-world challenges and societal needs (Figure 1).
- **Members:** GEAR Lab is founded in 2019 and directed by Dr. Lei Zou, Assistant Professor in the TAMU Department of Geography. Currently, the lab has five Ph.D. students, one master's student, and one undergraduate student.
- **Websites:**
    - Lab Website: https://www.geoearlab.com/
    - Faculty Profile: https://geography.tamu.edu/people/profiles/faculty/zoulei.html
    - Google Scholar: https://scholar.google.com/citations?hl=en&user=VRndhQEAAAAJ
- **Contact:** Lei Zou, Assistant Professor, lzou@tamu.edu
- **Social Media:** X (SKNA Twitter): Ray_GISer

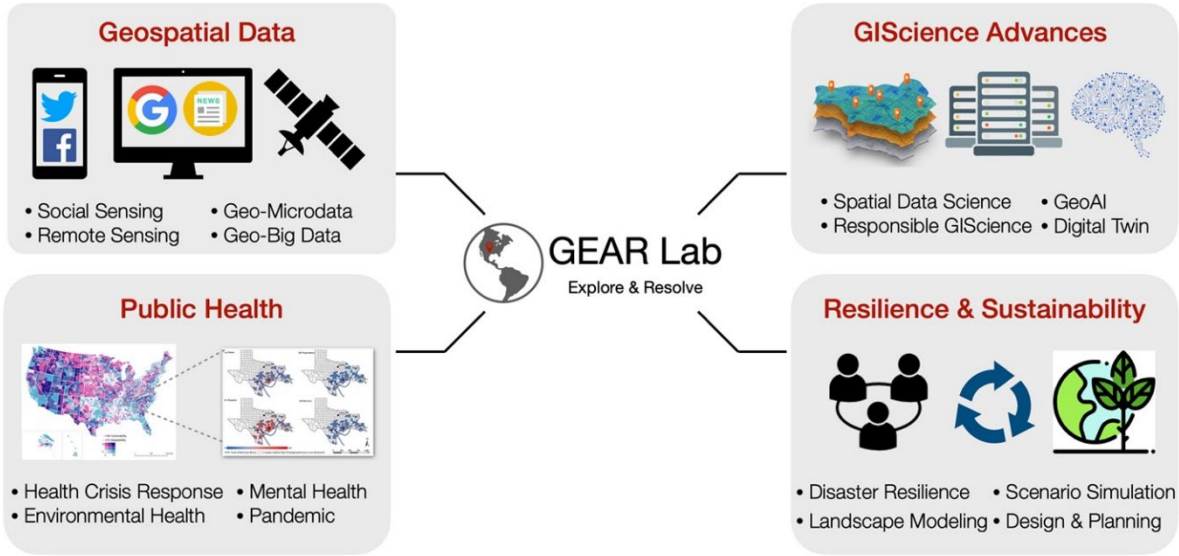


Figure 1. The four research themes in the GEAR Lab, including Geospatial Data Mining, Advanced GIScience Theories and Methods, Geospatial Approaches to Strengthening Public Health, and GIScience for a Resilient and Sustainable Future.

Publications

Members of the GEAR Lab have published over 60 articles in peer-reviewed journals, academic conferences, book chapters, and national reports. Five notable recent publications by GEAR Lab members are listed below.

- Zou, L., Liao, D., Lam, N.S., Meyer, M.A., Gharaibeh, N.G., Cai, H., Zhou, B. and Li, D. 2023. Social media for emergency rescue: An analysis of rescue requests on Twitter during Hurricane Harvey. *International Journal of Disaster Risk Reduction*, *85*, p. 103513. https://doi.org/10.1016/j.ijdrr.2022.103513
- Lin, B., Zou, L., Duffield, N., Mostafavi, A., Cai, H., Zhou, B., Tao, J., Yang, M., Mandal, D. and Abedin, J. 2022. Revealing the linguistic and geographical disparities of public awareness to Covid-19 outbreak through social media. *International Journal of Digital Earth*, *15*(1), pp. 868-889. https://doi.org/10.1080/17538947.2022.2070677
- Zhou, B., Zou, L., Mostafavi, A., Lin, B., Yang, M., Gharaibeh, N., Cai, H., Abedin, J. and Mandal, D. 2022. VictimFinder: Harvesting rescue requests in disaster response from social media with BERT. *Computers, Environment and Urban Systems*, *95*, p. 101824. https://doi.org/10.1016/j.compenvurbsys.2022.101824
- Yang, M., Zou, L., Cai, H., Qiang, Y., Lin, B., Zhou, B., Abedin, J. and Mandal, D., 2022. Spatial–temporal land loss modeling and simulation in a vulnerable coast: A case study in coastal Louisiana. *Remote Sensing*, *14*(4), p. 896. https://doi.org/10.3390/rs14040896
- Zou, L., Lam, N.S., Shams, S., Cai, H., Meyer, M.A., Yang, S., Lee, K., Park, S.J. and Reams, M.A. 2019. Social and geographical disparities in Twitter use during Hurricane Harvey. *International Journal of Digital Earth*, *12*(11), pp. 1300-1318. https://doi.org/10.1080/17538947.2018.1545878

Awards and Honors

GEAR Lab members have received multiple awards and honors over the past years. Some notable awards and honors are listed below.

Lei Zou (Lab Director):

- Global Young Scientist Award (10/150+), World GIS Developers Conference, 2022. The award is given to rising star scholars who have made significant contributions to cartography and GIScience theories, methods, and applications.
- Best Paper Award (1/35), International Symposium on Geospatial Approaches to Combating COVID-19, 2021. This honor awards the best presentation at an international pre-conference symposium of the 2021 International Cartographic Conference.
- International Cartography Association (ICA) Scholarship Award, 30th International Cartographic Conference, 2021. The ICA scholarship award offers selected early-career researchers the opportunity to participate in international or regional cartography conferences.

Joynal Abedin (Ph.D. Student):

- TAMU Department of Geography Excellence in Teaching Award, 2023
- ICA Scholarship Award, 2023
- American Association of Geographers (AAG) Research Grant Award (one of three awardees annually), 2023
- AAG Graduate Student Affinity Group Research and Support Award, 2023
- AAG Hazards, Risk, and Disasters Specialty Group (HRDSG) Jeanne X. Kasperson Student Paper Award, 2023

Binbin Lin (Ph.D. Student):

- ICA Scholarship Award, 2023

- AAG Spatial Analysis and Modeling Specialty Group Travel Award, 2023
- 2nd Place, AAG Geographic Information Science and Systems Specialty Group (GISSSG) Student Paper Competition, 2023
- Cartography and Geographic Information Society (CaGIS) Student Assistant Award for AutoCarto, 2022
- 1st Place, Graduate Student Paper Competition at Texas GIS Day, 2022
- TAMU Department of Geography Excellence in Research Award, 2022

Bing Zhou (Ph.D. Student):

- CaGIS Student Assistant Award for AutoCarto, 2022
- CaGIS Scholarship Award, 2021
- 1st Place, AAG GISSSG Student Paper Competition, 2021

Debayan Mandal (Ph.D. Student):

- Travel Award to attend NSF I-GUIDE Summer School, 2023 (30/80)
- CaGIS Student Assistant Award for AutoCarto, 2022
- U.S. National Committee Travel Award to attend ICC 2021

Mingzheng Yang (Ph.D. Student)

- AAG SAM Specialty Group Travel Award, 2021

Tarik Brown (MS Student)

- AAG HRDSG Jeanne X. Kasperson Student Paper Award, 2023

Other Significant Information or Initiatives

The GEAR Lab members have spearheaded many research projects funded by the National Science Foundation (NSF), National Academies of Sciences, Engineering, and Medicines (NASEM), American Association of Geographers (AAG), Cartography and Geographic Information Society (CaGIS), and U.S. Department of Veteran Affairs. Some recent projects are listed below.

Strengthening Environmental Health in Overburdened Communities

Southeast Texas has long borne the brunt of poor localized air and water quality, partially due to emissions from petrochemical facilities and frequent coastal hazards. Ongoing climate change will cause more extreme events, exacerbating environmental hazards and health crises in these already overburdened communities. This necessitates an urgent effort to quantify future environmental health disparities under climate change in these communities to inform mitigation strategies. To address this issue, as the principal investigator, GEAR Lab director Dr. Lei Zou spearheads a $1.5 million NASEM-funded project, titled “Climate-LEAD: Climate Effects on Localized Environmental Health Disparities in Overburdened Texas Communities along Gulf Coast.” This project will develop first-ever fine-scaled, localized databases, models, and tools to predict near-, mid-, and long-term impacts of climate change-intensified air pollution and water insecurity on health disparities in overburdened Texas communities along the Gulf Coast. An interactive WebGIS platform will be established to visualize and simulate climate change and environmental hazard effects on health, informing the design of policy, infrastructural, and individual interventions to curtail future environmental health impacts in targeted communities.

Big Geospatial Data and AI for Emergency Management

The popularity of analyzing big geospatial data for different applications, including disaster management, has grown in recent years. However, drawing scientific conclusions from big geospatial data and applying them in practice is challenging due to the technical difficulties in obtaining valuable information from such big, noisy, and biased datasets. Funded by NSF, the GEAR Lab develops intelligent models to extract unbiased, fine-scaled geographical information from big geospatial data for disaster management. Specifically, members from the lab have designed advanced GeoAI algorithms to extract disaster-related information from social and news media data, built statistical models to predict flash flood fatalities and economic losses, and revealed the geolocating algorithmic uncertainties and demographic bias of social media for disaster management.

Urban Digital Twins for Coastal Sustainability

Approximately 40% of the global population resides in coastal areas and faces multiple threats from climate change, while the coastal landscape is affected by human activities. The key to sustainable development is to forecast landscape changes, as well as their impacts, and plan ahead. The GEAR Lab is supported by NSF to create intelligent digital twins for coastal communities. This is accomplished using GIS, sensor networks, and 3D models to inform decision- and policy-making. We designed AI-based algorithms for land loss modeling and simulation in coastal Louisiana under various climate change conditions. We also modeled the impacts of land loss and flood risks on urban sprawl patterns in the contiguous United States at multiple geographical scales.

Geospatial Approaches to Combating Health Crisis

Health crises like COVID-19 have presented an unprecedented challenge to public health. Governments implemented various policies, while communities and residents showed diverse awareness and behaviors, leading to uneven health impacts. These non-pharmacological interventions (NPIs) play significant roles in combating COVID-19 but are difficult to quantify. Funded by the TAMU Institute of Data Science, the GEAR Lab creates global geodatabases of COVID-19 NPIs and explains their interplay and health consequences using various geospatial big datasets. The geodatabases can be leveraged to measure the spatial-temporal changes and disparities of NPIs at multiple scales and examine their compounding health impacts during various COVID-19 outbreak waves in different regions.

CyberGIS for Resilience Computation and Visualization

To enable long-term sustainability, we must build cities resilient to hazard threats. However, evaluating community resilience is challenging due to the inconsistency of variable selections, disparities of hazard types, and insufficient validation of measuring methods. To resolve these challenges, the GEAR Lab receives grants from TAMU to develop an improved resilience inference measurement (iRIM) model to evaluate disaster resilience and generate policy implications. We developed easy-to-use cyberinfrastructures for resilience assessment and geo-visualization. The platform provides information for public users to learn about their local disasters, retrieve resilience statuses, and acquire disaster preparedness and response knowledge, in addition to obtaining adaptation strategies on resilience enhancement.

- **Name of Lab:** University of Oregon Department of Geography, CartoFish Lab
- **Mission Statement:** The CartoFish Lab is focused on research at the intersection of cartography and environmental communication. We research how to effectively communicate climate change through maps and the ways in which maps are used in climate change discourse. We use a combination of quantitative and qualitative methods of data collection and analysis to illustrate how the media and scientists create and design maps that balance communication and scientific accuracy. Graduate and undergraduate students participate in collaborative research projects. The CartoFish Lab also is working to build larger research and practical relationships with a host of other units across the university including the InfoGraphics Lab and the Center for Science Communication Research.
- **Members:** Currently the CartoFish lab is composed of one faculty member, one postdoctoral scholar shared with the Center for Science Communication Research, two master's students, and two undergraduate students who work for the InfoGraphics Lab and do research with the CartoFish Lab.
- **Website:** https://www.carolynfish.com/
- **Contact:** Carolyn Fish, Assistant Professor, cfish11@uoregon.edu
- **Social Media:** @cartofish

Significant or Signature Events

The Director of The CartoFish Lab, Dr. Fish has been invited to give several invited lectures at major internationally recognized institutions including the University of Pennsylvania, University of Wisconsin, Harvard University, and the University of Münster. These lectures have focused on the main thrust of research in the lab on climate change communication.

Invited Talks

- Fish, C.S. (presenter). *Research Talk: Finding Context Without a Map: Carolyn Fish on Contextual Cartographic Research.* University of Pennsylvania Penn Institute for Urban Research Urban Spatial Analytics Program & Weitzman School of Design McHarg Environmental Modeling Center. Philadelphia, PA. April 13, 2023. https://penniur.upenn.edu/events/finding-context-without-a-map-carolyn-fish-on-contextual-cartographic-research
- Fish, C.S. (presenter). *#MUSA Master Class: Small Cartographic Adjustments for Designing Better Maps.* University of Pennsylvania Penn Institute for Urban Research Urban Spatial Analytics Program & Weitzman School of Design McHarg Environmental Modeling Center. Philadelphia, PA. April 13, 2023. https://www.carolynfish.com/masterclass
- Fish, C.S. (presenter). *The Albatross: How Cartographic Silence Frames Conservative Media's Climate Change Denial.* University of Oregon Department of Geography Colloquium. Eugene, OR. October 13, 2022.
- Fish, C.S. (presenter). *Cartographic Communication of Climate Change.* University of Wisconsin-Madison Department of Geography Yi-Fu Tuan Lecture. Madison, WI. March 11, 2022.

- Fish, C.S. (presenter). *Cartography for Communication: Politics and Climate Change.* University of Puget Sound and University of Washington Tacoma REU Site: Spatial Models and Electoral Redistricting (NSF Award #1851696). Tacoma, WA, July 9, 2021. https://www.nsf.gov/awardsearch/showAward?AWD_ID=1851696&HistoricalAwards=false.
- Fish, C.S. (presenter) and Michala Garrison. *Map Stories for Climate Change Communication.* Harvard University Center for Geographic Analysis Virtual Forum 2021: Geographic Data Science and Public Policy. Virtual. June 30, 2021. https://gis.harvard.edu/event/cga-virtual-forum-2021-geographic-data-science-and-public-policy.
- Fish, C.S. (presenter). *From the media to storytelling maps: The ways in which maps connect the public to climate change.* University of Münster, Institute for Geoinformatics GI Forum. Virtual. June 22, 2021. https://www.uni-muenster.de/Geoinformatics/en/GI-Forum/index.php.
- Fish, C.S. (presenter). *Cartographies of Climate Change.* Oregon State University College of Earth, Ocean, and Atmospheric Sciences. Corvallis, OR, June 16, 2021.
- Fish, C.S. (presenter). *Creating User Friendly Maps for Experts & Storytelling Maps for Everyone on Ocean Acidification & Hypoxia.* State of the Coast Conference-Oregon Sea Grant. Virtual. November 6, 2020. https://seagrant.oregonstate.edu/state-coast/program.
- Fish, C.S. (presenter). *What do maps have to do with emotions and climate change?* IntroDUCKtion: UO Student Orientation. Eugene, OR, August 6, 2020. https://www.youtube.com/watch?v=Y_1I7iOclEw&ab_channel=OregonWelcome.

Conference and Symposium Presentations

The graduate and undergraduate students who are part of the CartoFish Lab have presented at many conferences and symposia, including the annual meetings of the North American Cartographic Information Society (NACIS) and the American Association of Geographers (AAG) where their presentations have focused on the wide range of cartographic research topics at the University of Oregon, such as terrain mapping, climate change mapping, and map vividness.

** Students under my supervision

- Fish, C.S. (presenter). Cartography: A Translational Science for the Anthropocene? 118th Meeting of the American Association of Geographers, Denver, CO. March 24, 2023.
- Douglass, N.A.K.** (presenter) & C. Fish. That's a Relief: Assessing Aesthetic Preference and Landform Clarity in Terrain Maps. 2021 North American Cartographic Information Society (NACIS) Conference, Oklahoma City, OK. October 14, 2021.
- M. Garrison** (presenter) & C. Fish. Narrative Transportation, Emotions, and Climate Change Attitudes: Understanding Map Reader Response to Storytelling Maps. 2021 North American Cartographic Information Society (NACIS) Conference, Oklahoma City, OK. October 14, 2021.
- K. Quines Kreitzberg** (presenter) and C. Fish. Mapping an Echo Chamber: How Cartographic Silence Frames Right-Wing Media's Climate Change Denial. 2021 North American Cartographic Information Society (NACIS) Conference, Oklahoma City, OK. October 15, 2021.
- Fish, C.S. (presenter) & M. Garrison. Map Stories for Climate Change Communication. NCAR Innovators Catalyzing Innovation through Convergent Research PI Symposium, Virtual. July 27, 2021.

- Fish, C.S. & N. Douglass (both authors were presenters). *Revamping an Introductory GIS Course for Online Delivery.* 2020 North American Cartographic Information Society (NACIS) Conference, Virtual. October 15, 2020.
- Fish, C.S. (presenter). *Who is telling the story of climate change with maps? The surprising cartographic silence of the far right.* 115th Meeting of the American Association of Geographers, Denver, CO. (cancelled)
- Fish, C. S. (presenter). *Vivid Maps of Climate Change: Do They Make a Difference?* 114th Meeting of American Association of Geographers, Washington, DC, April 3-7, 2019.
- Fish, C.S. (presenter). *Vivid Persuasion in Maps.* 2018 North American Cartographic Information Society (NACIS) Conference, Norfolk, VA, October 18, 2018.

Publications

The peer reviewed publications from members of the CartoFish lab are primarily focused on climate change mapping, but also include contributions about terrain mapping, animated mapping, sentiment analysis, and place names. Peer-reviewed articles from the CartoFish lab are collaborative efforts with the Director and her students allowing students to better understand the publication and peer-review process.

Peer-Reviewed Publications

- Fish, C.S. and K.Q. Kreitzberg*. (Accepted). Mapping in an Echo Chamber: How Cartographic Silence Frames Right-Wing Media's Climate Change Denial. *Annals of the American Association of Geographers.* DOI: 10.1080/24694452.2023.2227672.
- Douglass, N.A.K.** and C.S. Fish. (2022). That's a relief: Assessing beauty, realism, and landform clarity in multilayer terrain maps. *Cartographic Perspectives.* 100, 45-66. DOI: 10.14714/CP100.1727. https://cartographicperspectives.org/index.php/journal/article/view/1727/2091
- Retchless, D., C.S. Fish, J.Thatcher (2022). Climate Change Communication beyond the Digital Divide: Exploring cartography's role and privilege in climate action. *Journal of Environmental Media.* 3 (1), 101-123. DOI: https://doi.org/10.1386/jem_00074_1
- Fish, C.S. (2021). Elements of Vivid Cartography. *The Cartographic Journal*. DOI: 10.1080/00087041.2020.1800160
- Fish, C.S. (2020) Cartographic content analysis of compelling climate change communication. *Cartography and Geographic Information Science.* 47(6), 492-507. DOI: 10.1080/15230406.2020.1774421
- Fish, C. (2020) Storytelling for making cartographic design decisions for climate change communication. *Cartographica: The International Journal for Geographic Information and Geovisualization*. 55(2), 69–84. DOI: 10.3138/cart-2019-0019
- de Sherbinin, A., A. Bukvic, G. Rohat, M. Gall, B. McCusker, B. Preston, A. Apotsos, C. Fish, S. Kienberger, P. Muhonda, O. Wilhelmi, D. Macharia, W. Shubert, R. Sliuzas, B. Tomaszewski, S. Zhang. (2019). Climate Vulnerability Mapping: A Systematic Review and Future Prospects. *WIRES Climate Change*. 10(5), 1-23. DOI: 10.1002/wcc.600
- Fish, C.S. (2018). Spatiotemporal Representation. *The Geographic Information Science & Technology Body of Knowledge* (4th Quarter 2018 Edition), John P. Wilson (Ed.). DOI: 10.22224/gistbok/2018.4.6.

Book Chapters

- Hauthal, E., D. Burghardt, D., C. Fish, A.L. Griffin. (2020) "Sentiment Analysis" In (Kobayashi) *Encyclopedia of Human Geography*, Second Edition: Elsevier. Pp. 169-177. https://doi.org/10.1016/B978-0-08-102295-5.10593-1

Peer-Reviewed Extended Abstracts

- Fish, C.S., E. Guidero, P. Raposo, & R.E. Roth. *Research Approaches in Cartography: A Preliminary Review.* Proceedings of the 31st International Cartographic Conference. Cape Town, South Africa. August 2023.
- Sui, Z.* & C.S. Fish. *Endonyms or Exonyms: How map purpose, data source, and map language impact place naming on maps.* Proceedings of the 31st International Cartographic Conference. Cape Town, South Africa. August 2023.
- Fish, C.S. and A.L. Griffin. *Emotional responses to climate change map framing using facial emotion recognition technology.* Proceedings of the 29th International Cartographic Conference. Tokyo, Japan. July 2019.

Awards

CartoFish Lab members have won a number of awards in the past three years.

UCGIS TRELIS Fellow

In 2020, Carolyn Fish was selected through a competitive process to participate in TRELIS (https://www.ucgis.org/trelis), a year-long program of professional development for academic women in the geospatial sciences. This program is funded by the National Science Foundation (Award #1660400).

NACIS Student Map and Poster Competition, Research Category

Lab member, Michala Garrison, was selected to receive the NACIS Student Poster Award in 2020 after displaying her work at the 2020 NACIS Annual Meeting.

Bill Loy Award for Cartographic Excellence, University of Oregon

Lab members, Zhaoxu Sui (2023, honorable mention, Figure 1), Bill Limpisathian (2022), and Michala Garrison (2020), submitted cartographic products, and were selected to win this award which is based on cartographic excellence by a committee of judges.

Figure 1. Zhaoxu Sui, master's student and CartoFish Lab member, received honorable mention for the Bill Loy Award for Cartographic Excellence, May 2023.

- **Name of Lab:** University of Wisconsin Cartography Lab
- **Short Name:** UW Cart Lab or just Cart Lab
- **Mission Statement:** Established in 1953, the University of Wisconsin Cartography Lab is a full-service production facility providing both undergraduate and graduate students with a unique apprenticeship experience on research and design projects.
- **Members:** The UW Cart Lab is led by Director Dr. Robert Roth and Creative Director Dr. Alicia Cowart. The Cart Lab has two permanent graduate student positions: one 50%, nine-month Project Assistant (drawn from our thesis program candidates) and one 35%, 12-month Fellow (drawn from our professional program enrollees). The Cart Lab regularly employs an additional 10-12 part-time student employees, resulting in a team of roughly 15 people.
- **Website:** www.geography.wisc.edu/cartography/
- **Contact:** Robert Roth, Director and Professor, reroth@wisc.edu
- **Social Media:** twitter.com/@UWCartLab

Description

Established in 1953, the University of Wisconsin Cartography Lab (Cart Lab) is a full-service production facility providing both undergraduate and graduate students with a unique apprenticeship experience on research and design projects. The UW Cart Lab is led by Director Dr. Robert Roth and Creative Director Dr. Alicia Cowart. Like so many programs and labs, the COVID-19 global pandemic required considerable adaptation to our regular operations, as we exhibited a temporary slowdown in both client requests and student availability. To pivot, we intentionally focused our efforts during the pandemic on development of *open educational resources* (OERs) that support asynchronous and hybrid learning. OER initiatives undertaken by the UW Cart Lab since the 2019 General Assembly include: 1. The Cartography & Visualization section of the UCGIS *Geographic Information Science & Technology Body of Knowledge*, which now includes nearly 40 entries on cartographic design and use topics and includes learning objectives and practice questions for instruction, 2. *Web Mapping: A Workbook for Interactive Cartography and Visualization on the Open Web*—a comprehensive, 12-week course on JavaScript programming with the Leaflet.js and D3.js web mapping libraries, and 3. *Mapping for a Sustainable World*, the jointly-published United Nations and International Cartographic Association textbook on best practices for mapping the UN Sustainable Development Goals. Regarding the latter, the Cart Lab donated roughly $25,000 in student labor to create the overall book design and 227 original maps and graphics for the textbook, as well as a QGIS Technical Supplement providing technical instruction for recreating several of the maps in the book.

Significant or Signature Events

Design Challenge 2020: Spend the Day in the Newsroom

The Cart Lab leads an annual "Design Challenge"—a day-long, lock-in-like mapping event bringing together students, faculty/staff, and stakeholders around a community-engaged project.

- Science Hall, University of Wisconsin, Madison, WI

- 22 February 2020
- In-person
- 32 participants
- Special Guest: Lauren Tierney, *The Washington Post*

Design Challenge 2021: Play Cartography Password

- Science Hall, University of Wisconsin, Madison, WI
- 8-13 March 2021
- Asynchronous/Online
- 15 participants
- Special Guests: Daniel Huffman, somethingaboutmaps; Zihan Song, Esri; Kristen Vincent, City of De Pere GIS

Design Challenge 2022: K5 Cartography Curriculum Development

- Science Hall, University of Wisconsin, Madison, WI
- 12 February 2022
- In-person
- 27 participants
- Special Guest: Margene Anderson, Senior Educational Consultant, UW Center for Teaching, Learning and Mentoring

Design Challenge 2023: Visualize the Evolving Landscape of the Great Plains

- Science Hall, University of Wisconsin, Madison, WI
- 25 February 2023
- In-person
- 33 participants
- Special Guest: Joseph Mason, Professor, University of Wisconsin

Publications

Books & Open Educational Resources

- Houtman L* and Roth RE. 2021. Mapping for a Sustainable World: QGIS Technical Supplement. University of Wisconsin Cartography Laboratory: Madison, WI. doi.org/10.5281/zenodo.5585547 Online at: https://github.com/uwcartlab/MappingSDGsTechnicalSupplement
- Roth RE, *CM Sack, *G Baldrica-Franklin, *Y Chen, *R Donohue, *T Prestby, *R Tolochko, and *N Underwood. 2020. Web Mapping: A Workbook for Interactive Cartography and Visualization on the Open Web. University of Wisconsin Cartography Laboratory: Madison, WI. doi.org/10.5281/zenodo.5565480. Online at: https://github.com/uwcartlab/webmapping
- Kraak MJ, RE Roth, BA Ricker, A Kagawa, and G Le Sourd. 2020. Mapping for a Sustainable World. New York: United Nations Press. doi.org/10.18356/9789216040468

Journal Articles

- Roth RE, A Çöltekin, L Delazari, B Denney, A Mendonça, J Shen, Z Stachoň, and M Wu. (accepted) Making maps & visualizations for mobile devices: Research challenges for mobile-first and responsive cartographic design. Journal of Location Based Services.
- Hart D, *T Prestby, and RE Roth. 2022. Design and evaluation of coastal web atlases: Best

practices and future opportunities for map representation, interaction, and usability. Coastal Management. 50(6): 514-548. doi.org/10.1080/08920753.2022.2126271

- Song Z*, RE Roth, *L Houtman, *T Prestby, *A Iverson, and S Gao. 2022. Visual storytelling with maps: An empirical study on story map themes and narrative structures, map-based storytelling genres and tropes, and individual audience differences. Cartographic Perspectives. 100. Page forthcoming. doi.org/10.14714/CP100.1759
- Lumley S*, R Sieber, and RE Roth. 2022. A framework and comparative analysis of web-based climate change visualization tools. Computers & Graphics. 103(April): 19-30. doi.org/10.1016/j.cag.2021.12.007
- Bley K*, *K Caldwell, *M Kelly, J Loyd, RE Roth, TMB Andersen, A Bonds, J Plevin,, D Madison, C Spencer, T Sims, *C Archuleta, *Z Ellner, *T McDowell, *C Nestel, *E Noterman, *N Smith, *S Velednitsky, *N Underwood, *R Darlington, *Y Gao, *A George, *L Miller, *T Prestby, and*J Vongkusolkit. 2022. A Design Challenge for Transforming Justice. GeoHumanities. doi.org/10.1080/2373566X.2021.1986100
- Roth RE. 2021. Cartographic design as visual storytelling: Synthesis and review of map-based narratives, genres, and tropes. The Cartographic Journal. 58(1): 83-114. doi.org/10.1080/00087041.2019.1633103
- Loeffler S*, RE Roth, S Goring, and A Myrbo. 2021. Mobile UX design: Learning from the Flyover Country mobile app. The Journal of Maps. 17(2): 39-50. doi.org/10.1080/17445647.2020.1867247
- Han Y*, M Wu, and RE Roth. 2021. Towards green cartography and visualization: A semantically-enriched method of generating energy-aware color schemes for digital maps. Cartography and Geographic Information Science. 48(1): 43-62. doi.org/10.1080/15230406.2020.1827040
- Roth RE, *C Nestel, TMB Andersen, *J App, *M Cloutier, *C Guo, *A Iverson, *M Kohls, *J Lodermeier, *A McKindsey, *E Milligan, *P Nielsen, *C Palm, *E Pettit, *M Roessler, *N Underwood, and *G Vahl. 2020. Madison and Vicinity: A tangible map quilt. Cartographic Perspectives. 95: 50-56. doi.org/10.14714/CP95.1615
- Vincent K*, RE Roth, S Moore, Q Huang, *N Lally, *CM Sack, *E Nost, and *H Rosenfeld. 2019. Improving spatial decision making using interactive maps: An empirical study on interface complexity and decision complexity in the North American hazardous waste trade. Environment and Planning B. 46(9): 1706-1723. doi.org/10.1177/2399808318764122
- Roth RE. 2019. How do user-centered design studies contribute to cartography? Geografie. 124(2): 133-161. doi.org/10.37040/geografie2019124020133
- Kang Y*, S Gao, and RE Roth. 2019. Transferring multiscale map styles using generative adversarial networks. International Journal of Cartography. 5(2-3): 115-141. doi.org/ 10.1080/23729333.2019.1615729
- Moore SA, *H Rosenfeld, *E Nost, *K Vincent, and RE Roth. 2019. Undermining methodological nationalism: Cosmopolitan analysis and visualization of the North American hazardous waste trade. Environment and Planning A. 50(8): 1558-1579. doi.org/10.1177/0308518X18784023

- **Name of Lab:** Geospatial Analysis & Mapping Laboratory, Geography and Environmental Sciences, University of Colorado Denver
- **Short Name:** GAMLab
- **Mission Statement:** The Geospatial Analysis and Mapping Laboratory (GAMLab) provides resources and services to visualize, explore, analyze, and propose solutions to human-environmental challenges using Geographic Information Science and Technology. The GAMLab enables and supports the geospatial research activities of CU Denver's Department of Geography and Environmental Sciences (GES) faculty and students, in addition to facilitating collaborations between GES and other members of academic, government, private, and community sectors. The GAMLab offers mapping, visualization, and analysis services to both internal and external clients, including map production, informational graphics, digitizing, data compilation, spatial analysis, and consulting.
- **Staff:** 1 part-time (60%) Director, 2 to 8 part-time student workers
- **Website:** https://clas.ucdenver.edu/gamlab/
- **Contact:** Please use the contact form at https://clas.ucdenver.edu/gamlab/content/contact-gamlab or email Mandy Rees, Interim Director, amanda.rees@ucdenver.edu

Description

The GAMLab is a newly established research and service center in the Department of Geography and Environmental Sciences at the University of Colorado Denver (CU Denver). Starting in 2020, inaugural GAMLab Director Alicia Cowart established the processes and procedures for the lab, which now continues under the direction of Interim Director Mandy Rees as of July 2023.

The GAMLab provides fee-for-service and grant-funded mapping products to internal and external clients, while employing CU Denver students who gain work experience and networking opportunities through their involvement in the lab. The GAMLab is the only established service center within the College of Liberal Arts & Sciences (CLAS) at the University of Colorado Denver, and it is the only center providing geospatial and mapping services within the University of Colorado system.

THE GEOGRAPHICS LAB

Cartographic design, production, & research

- **Name of Lab:** The GeoGraphics Lab, Peter R. Gould Center for Geography Education and Outreach, The Pennsylvania State University (PSU)
- **Mission Statement:** Located in the PSU Department of Geography, the GeoGraphics Lab provides cartographic design, production, and research services. The GeoGraphics Lab is a multimedia cartography laboratory at the Penn State Department of Geography, administered in part through support from the Peter R. Gould Center for Geography Education and Outreach. Our clients include commercial, nonprofit, and government organizations, members of the central Pennsylvania community, as well as PSU Geography students and faculty. We offer professional geospatial visualization services, including map design, production, and research. Our specialty is static print and digital maps, but we offer solutions for interactive digital maps as well.
- **Employees:** Eight
- **Website:** https://geographics.psu.edu/
- **Contact:** Harrison Cole, Creative Director, geographics@psu.edu

Significant Events

New Lab Grand Opening

- September 8th, 2023
- PSU, University Park, PA
- In-person colloquium and reception

Other Significant Information

Lab Research Equipment

- Industry-grade large format printer; 3D printer; Swell Form machine/fuser (for tactile graphics printing); eye tracking and user biometrics analysis tools; virtual reality headsets (Figure 1).

Figure 1. Inside the GeoGraphics Lab.

Recent Projects

- We worked with environmental artist Stacy Levy to design an approximately 200 square foot map of contemporary and historical hydrological data of the Alameda Creek Watershed. This map was sandblasted into Pennsylvania bluestone. It is to be installed at the Alameda Creek Watershed Center in Sunol, California (https://sfpuc.org/construction-contracts/construction-projects/alameda-creek-watershed-center-in-Sunol). The map will serve as the floor of an observation patio.
- We are working with Dr. Cynthia Brewer to design maps for a renovation of the Eric A. Walker Building's 2nd and 3rd floors, which houses the PSU Department of Geography (Figure 2). The centerpiece will be a series of large (16 to 28 ft^2), illuminated resin panels mounted to the wall outside the main office. Each map will feature a different continent and a different dataset representing a different theme in geography. However, all will, in some way, illustrate relationships between humans and the environment.

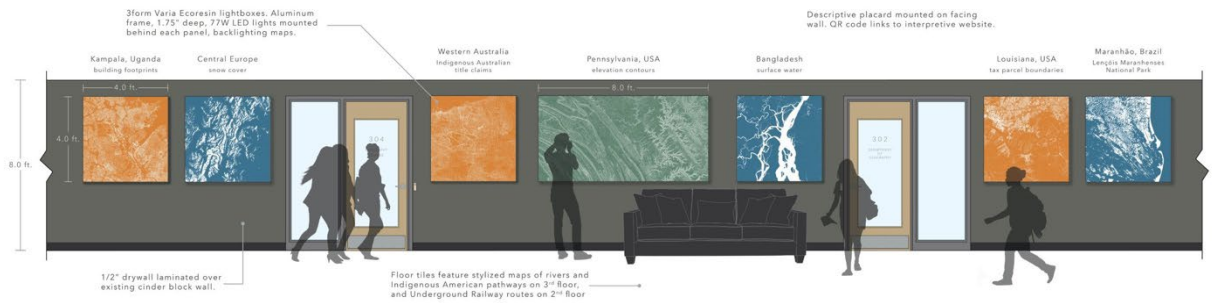


Figure 2. Rendering of the Walker Building hallway map installation.

- **Name of Organization:** InfoGraphics Lab, University of Oregon
- **Acronym:** IGL
- **Mission Statement:** Our mission is to generate meaning and impact through data and design. We practice, teach, and study creative data-driven design and cartography, fostering collaboration across diverse disciplines to transform research, discover and communicate insights, and engage with pressing societal and environmental challenges.
- **Staff:** 3–5 regular staff, 10–15 students, 1 emeritus, and 10–15 faculty affiliates. Key full-time staff members include Erik Steiner (Director), Alethea Steingisser (Cartographic Production Manager), and Joanna Merson (Cartographic Developer).
- **Website:** https://:infographics.uoregon.edu
- **Contact:** Erik Steiner, Director, steiner@uoregon.edu
- **Social Media:** https://www.linkedin.com/company/university-of-oregon-infographics-lab/; https://twitter.com/InfoGraphicsLab

Description

The InfoGraphics Lab is a center of excellence and innovation in geospatial research and cartography at the University of Oregon. As a hybrid research and practice community, the IGL seeks to advance research in diverse domains and develop high quality interactive and print products that evoke, inspire and communicate.

Over its 35-year history, the IGL has been recognized for its accomplishments and innovations in three major work areas: the production of a series of major award-winning print atlases; the creation of interactive map experiences on desktop, web, and mobile platforms; and the development of a mapping and geospatial data infrastructure for campus wayfinding and university operations. The IGL is also recognized as a center of excellence in teaching and training undergraduate and graduate students through formal course offerings in and experiential learning programs. Students contribute to published works and research projects in a variety of roles, such as project managers, researchers, designers, analysts, and developers. This training serves career trajectories into industry and government, as well as academia.

The lab's future is oriented toward maintaining its existing profile as a center of design excellence, while growing its impact through interdisciplinary collaborations and academic research in visualization and cartography. As the field of cartography evolves to encompass diverse data science technologies, analytic and communication purposes, and conceptual to traditional map products, the IGL is engaging in a range of projects that involve modeling, analytics, design, and user experience. Ongoing joint research projects in history, economics, ecology, law, journalism, environmental justice, architecture, digital humanities, and other disciplines highlight the integral role—both technical and theoretical—that data and design play in advancing knowledge and making a meaningful impact on society and the planet.

Recent Updates

The growth and success of our campus mapping programs led to the creation of a new organization in 2016, the Location Innovation Lab, to develop custom applications for the University of Oregon for campus operations, emergency management, and business continuity.

In 2021, long-time lab director James Meacham announced his retirement after more than three decades of service to the Lab and the broader discipline of cartography. In November 2022, the University of Oregon named a new director, Erik Steiner, a former employee of IGL who co-founded the Center for Spatial and Textual Analysis (CESTA) at Stanford University.

Major recent accomplishments of the IGL include the publication of the *Atlas of Yellowstone, Second Edition* (see below), the publication of three major USGS Reports on ungulate migration. Ongoing digital interactive work includes the forthcoming publication of *Chronographics: The Time Charts of Joseph Priestley*, the development of the University of Oregon's *Sustainability Dashboard* (https://sustainability.uoregon.edu/), and an ongoing web-mapping collaboration with the Network Startup Resource Center (NSRC). Beyond these recent projects, we maintain and more than a dozen collaborations with faculty across the university and beyond.

Recent Awards

- 2022, Cartography and Geographic Information Society (CaGIS), Annual Map Competition "Best in Show" and "Best Atlas" Awards. Title: Atlas of Yellowstone, Second Edition.
- 2020 Renewable Natural Resources Foundation Outstanding Achievement Award. Title: Wild Migrations: Atlas of Wyoming Ungulates.
- 2019, The Wildlife Society, Wildlife Publication Award for an Edited Book. Title: Wild Migrations.
- 2019, High Plains Book Award Finalist. Title: Wild Migrations.

Significant Projects

Atlas of Yellowstone, Second Edition

The *Atlas of Yellowstone, Second Edition* celebrates the 150th anniversary of the establishment of Yellowstone National Park (Figure 1, Figure 2). The atlas is a comprehensive visual reference that presents Yellowstone stories through maps, data visualizations, photography, and text that is accessible by park visitors and scientists alike. Topics range from the founding of the park, social equity, climate and landscape change, to imagining the next 150 years. Nearly every method of thematic mapping is employed. This new edition explores the contributions of Yellowstone to understanding and preserving physical and cultural landscapes, and to inspiring national parks and preserved areas around the world.

- *Atlas of Yellowstone, Second Edition*
- By W. Andrew Marcus, James E. Meacham, Ann W. Rodman, Alethea Y. Steingisser, Justin T. Menke, and Ross West
- Published by University of California Press, January 2022, copyright © 2022, University of California Press

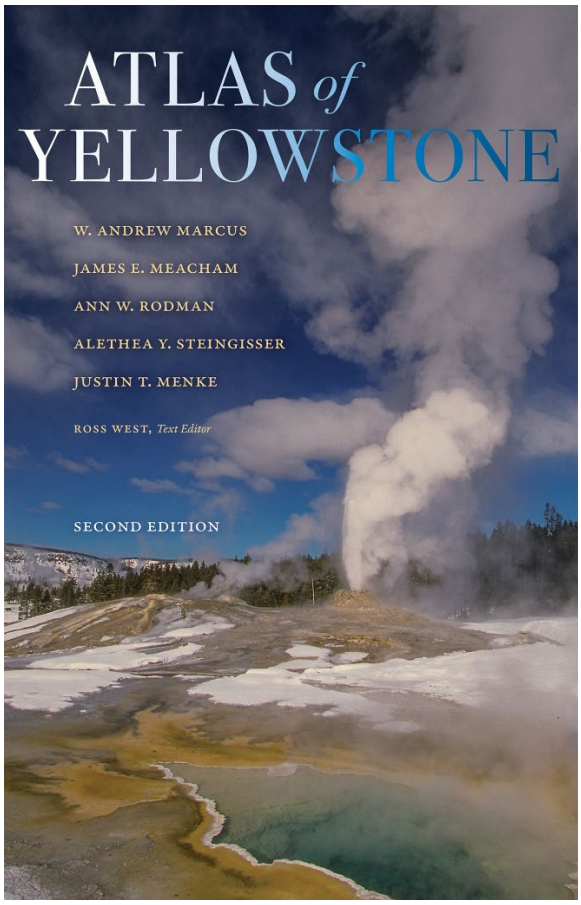
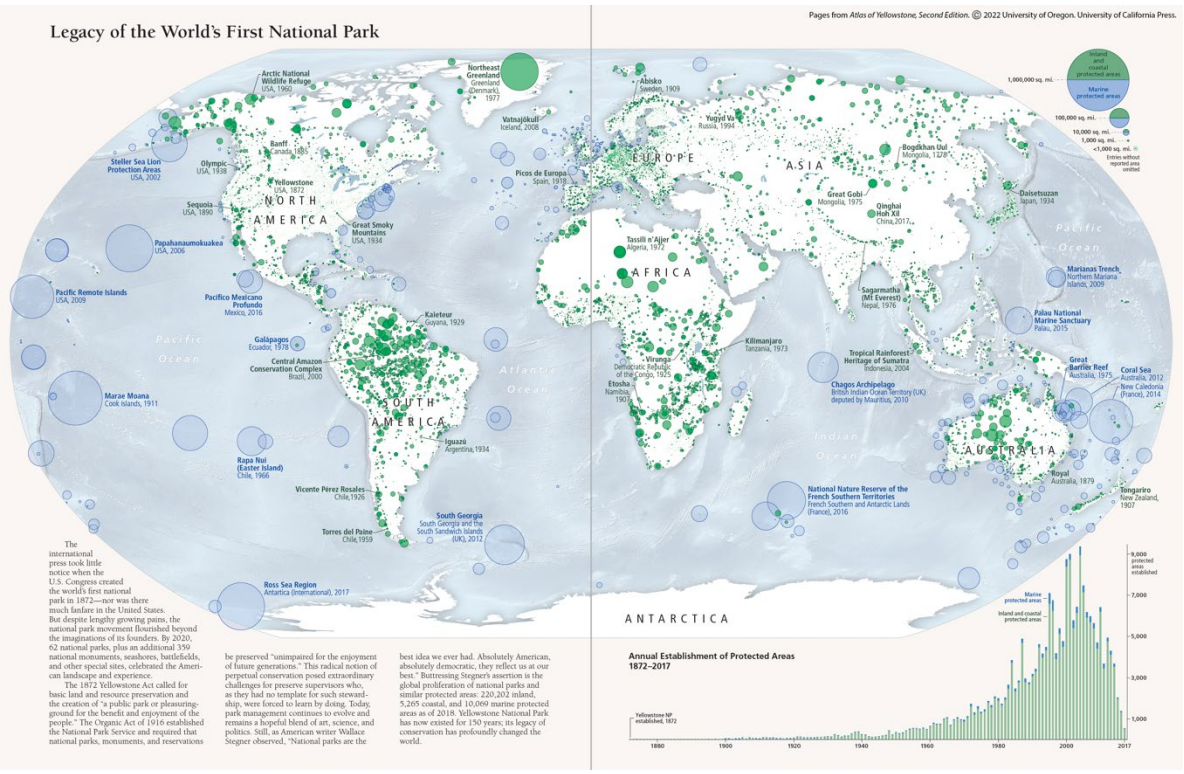


Figure 1: *Atlas of Yellowstone, Second Edition* cover image. © 2022 University of Oregon. University of California Press.

Figure 2: *Atlas of Yellowstone, Second Edition* Legacy of the World's First National Park: a page layout



depicting the protected areas around the world. © 2022 University of Oregon. University of California Press.

Ungulate migrations of the Western United States

The *Ungulate migrations of the Western United States, Volumes 1–3: U.S. Geological Survey Scientific Investigations Report* is an annual comprehensive report produced in collaboration with dozens of scientists, wildlife management agencies, Federal partners, and Tribal Nations, aimed at documenting and mapping the migrations and seasonal ranges of numerous ungulate herds across the western United States to aid in local conservation, management, and policy efforts.

- *Ungulate migrations of the Western United States, Volumes 1–3: U.S. Geological Survey Scientific Investigations Report*
- By Matthew Kauffman, Blake Lowrey, et al.
- Published by United States Geological Survey, copyright © 2019–2022

Sustainability Dashboard

The University of Oregon's *Sustainability Dashboard* (https://sustainability.uoregon.edu/) is a dynamic platform serving as a living lab for teaching and research on campus sustainability. Showcasing over 20 metrics collected by various institutional offices and departments, data is presented through maps, infographics, and interactive charts, with sensitive information aggregated, and continual updates of additional data and topics.

- **Name of Lab:** Western Illinois University GIS Center
- **Acronym:** WIU GIS Center
- **Mission Statement:** The GIS Center's mission is to provide GIS and mapping services to stakeholders throughout western Illinois while providing students real-world opportunities for fieldwork, data analysis, and application building.
- **Members:** The GIS Center is directed by Mr. Chad Sperry and has two full-time employees. The Center also employs approximately ten students, at both the master's and undergraduate levels. The Center also has eight Faculty Associates representing four academic departments at WIU.
- **Websites:** Center Homepage: http://www.wiu.edu/cas/gis_center/, Center Mapping Applications Site: http://www.wiu.edu/cas/gis_center/webmaps.php
- **Faculty Associates:** http://www.wiu.edu/cas/gis_center/associates.php
- **Contact:** Chad Sperry, Director, ce-sperry@wiu.edu

Description

The GIS Center provides GIS and mapping services to stakeholders throughout western Illinois, a part of the state that is predominantly rural and lacking staffed city and/or county GIS positions. The Center is housed in the Western Illinois University (WIU) Department of Earth, Atmospheric, and Geographic Information Sciences. Critical to the Center's activities is its role in providing WIU students real-world GIS experience working with a variety of governments as well as state agencies. The students working in the Center work on all projects and are required to have taken GIS courses as a condition of employment.

Significant Recent Accomplishments

- Creation of authoritative data layers for 20 counties in Illinois to integrate with the upcoming implementation of the statewide Next-Generation 911 system.
- Lead pipe service inventories for the cities of Silvis, Illinois and Macomb, Illinois.
- Cemetery mapping (including online maps) for Macomb, Illinois and Good Hope, Illinois.
- Created online map of warming centers for the Illinois Emergency Management Agency during January 2020.
- Creation of web maps and a dashboard for the response to the 2019 flooding of the lower Illinois and Mississippi Rivers, with the Illinois State Police and Illinois National Guard.
- Taylorville Tornado Response support involving drone imagery, mapping, and story mapping of damage that incurred when a 2018 tornado struck Taylorville, Illinois.
- Creation of *Dine Smart* web map of locations and inspection results of licensed food service establishments for the McDonough County, Illinois, Health Department.

Publications

- *Road Atlas of Fulton County, Illinois*
- *Road Atlas of McDonough County, Illinois*
- *Cheyenne River Sioux Reservation (SD) Map Book*
- *Brown County Illinois Map Book*

- **Name of Agency:** U.S. Census Bureau
- **Short Name:** Census Bureau
- **Mission Statement:** The Census Bureau's mission is to serve as the nation's leading provider of quality data about its people and economy.
- **Staff:** More than 4,000 staff members
- **Website:** https://www.census.gov/
- **Contact information:** Census Bureau Customer Service Call Center (ask.census.gov; 301-763-INFO or 800-923-8282) or Public Information Office (pio@census.gov; 301-763-3030 or 877-861-2010).
- **Social Media:**
    - Facebook: https://www.facebook.com/uscensusbureau
    - X (SFKA Twitter): https://twitter.com/uscensusbureau
    - LinkedIn: https://www.linkedin.com/company/us-census-bureau/
    - YouTube: https://www.youtube.com/user/uscensusbureau
    - Instagram: https://www.instagram.com/uscensusbureau/

Description

The U.S. Census Bureau and the Geographic Support Program (GSP) supports and maintains the geographic and cartographic infrastructure necessary for the Census Bureau's data collection processing, tabulation, and dissemination programs for the United States, Puerto Rico, and Island Areas. This program aims to provide the most current, accurate, and complete address, feature, imagery, and boundary data to the Census Bureau's customers and data users and build the geographic foundation for every economic and social data product produced by the Census Bureau. This program provides the geographic reference files that are needed for all Census Bureau programs, censuses, surveys, and related field operations, such as the Economic Census, the Current Demographic Statistics program, the Intercensal Demographic Estimates program, the American Community Survey (ACS), and the Decennial Census. The Census Bureau integrates high-quality data provided by more than 40,000 tribal, federal, state, and local government partners to validate and update address, feature, and boundary information in the MAF/TIGER System. Census Bureau programs, such as the Boundary and Annexation Survey (BAS), the Participant Statistical Areas Program (PSAP), Redistricting Data Program (RDP), and the Local Update of Census Addresses Operation (LUCA) were conducted during the decade leading up to the 2020 Census.

Publications

Spatial Files, Reference Files, and Services (2020 Census and Annual Files)

- TIGER/Line Shapefiles and TIGER/Line Geodatabases: Extracts of geographic area boundaries, areal features, linear features, and point features from the MAF/TIGER System (MTS) in shapefile and file geodatabase formats.
- TIGER/Line with Selected Demographic and Economic Data: Extracts of geographic area boundaries joined to selected data from the American Community Survey 5-year Estimates.

- Cartographic Boundary Files: Generalized representations of geographic area boundaries in shapefile, file geodatabase, and KML formats.
- TIGERweb Services: REST Services and WMSs for geographic area boundaries, areal features, and linear features.
- Relationship Files: Files showing relationships between two types of geography for the same period or relationships between the same type of geography over time.
- Gazetteer Files: Listings of geographic areas for selected geography area types with codes, names, area measurement, and representative latitude and longitude coordinates.
- Address Count Listing Files: Files containing housing unit and group quarters counts by census block.

Static Map Products

- 118th Congressional District Wall Maps: Includes a national map, state-based maps, and district-based maps.
- 2022 State Legislative District Reference Maps: Includes individual district-based maps.
- 2020 Census P.L. 94-171 Redistricting Data Map Suite: Includes four reference map types that support the 2020 Census Redistricting Data Program.
- 2020 American Indians and Alaska Natives in the United States Wall Maps: Maps show the American Indian and Alaska Native Areas reported or delineated for the 2020 Census.
- 2020 Population Distribution of the United States and Puerto Rico Maps: Wall map and page-size map depicting the population distribution of the U.S. and Puerto Rico as a dot map.
- 2020 Census Urban Areas Wall Map: Shows the location and name of all urban areas delineated for the 2020 Census.
- Boundary and Annexation Survey (BAS) Maps: Maps made available to governments for use in the annual Boundary and Annexation Survey.

Interactive Map Products

- TIGERweb: Map application for visualizing geographic data from TIGER.
- 2020 Census Demographic Data Map Viewer: Map application that displays a variety of thematic maps for variables from the 2020 Census.
- 2020 Census Quality Metrics Viewer: Map application that displays operational quality metrics from the 2020 Census for counties and census tracts.
- Centers of Population Story Map: Story map that highlights historical centers of population, 2020 centers of population, and commemorative marks.
- EDA-Census Poverty Viewer: Map application developed by the U.S. Census Bureau to support the Commerce Department's Economic Development Administration displays high poverty areas and persistent poverty counties.
- Puerto Rico Predominant Address Type Viewer: Map application that displays the predominant address type by census block in Puerto Rico.
- Community Resilience Estimates for Puerto Rico Viewer: Map application that displays the social vulnerability in Puerto Rico in the event of a disaster.
- Boundary and Annexation Survey (BAS) Viewer: Map application that displays governments participating in BAS and government response to BAS.
- Digital Equity Act Population Viewer: Map application that displays maps that enable users to locate and understand unserved and underserved populations.

- ACCESS BROADBAND Dashboard: Map application that displays maps for users to assess economic conditions in areas with changes in broadband availability and adoption.
- Census Address Count Listing Files Viewer: Map application that supplements the address count listing files to display housing unit and group quarters counts by block.

Other Significant Information or Initiatives

- The most current legal, statistical, and administrative boundaries and names collected by the Census Bureau are available as TIGER/Line Shapefiles.
- Public Law (P.L.) 94-171 requires the Census Bureau to provide states the opportunity to identify the small area geography for which they need data to conduct legislative redistricting. The Census Bureau's release of 2020 redistricting data to all states occurred on August 12, 2021. Changes were provided from non-partisan state liaisons through the 2020 Redistricting Data Program and incorporated into the MAF/TIGER System. Verification materials were sent to each state by August 31, 2022. The final wall map series for congressional districts and legislative districts was published online on April 28, 2023.
- In December 2022, the Census Bureau announced the final qualifying urban and rural classification as an important baseline for analyzing changes in the distribution and characteristics of urban and rural populations and housing in the United States and Territories (see Urban and Rural (census.gov)). Federal, states, local, and nongovernmental organizations stakeholders use the Census Bureau's urban-rural classification for allocating program funds and implementing aspects of their programs.
- The Census Bureau and the Department of Housing and Urban Development collaborated on The Opportunity Project Summer 2022 Sprints – Transforming Local Addressing Systems in Puerto Rico. Two Puerto Rico-based map viewers were developed to assist the private technology companies and non-profit companies that participated in the sprints.

- **Name of Organization:** National Oceanic and Atmospheric Administration, Office of Coast Survey, Marine Chart Division
- **Acronyms:** NOAA, OCS, MCD
- **Mission Statement:** Coast Survey maintains the nation's nautical charts and publications for U.S. coasts, the Great Lakes, and outlying territories. The Marine Chart Division creates and maintains a suite of over a thousand charts covering 95,000 miles of shoreline and 3.4 million square nautical miles of water. We support the 1.3 billion metric tons of cargo valued at $1.8 trillion that comes in and out of U.S. ports every year.
- **Employees:** 94 Federal employees and 18 contractors
- **Website:** https://nauticalcharts.noaa.gov/
- **Contact:** https://nauticalcharts.noaa.gov/customer-service/assist/
- **Social Media:**
    - Facebook: https://www.facebook.com/NOAAcharts
    - X (SFKA Twitter): https://twitter.com/NOAAcharts
    - LinkedIn: https://www.linkedin.com/showcase/noaa-coast-survey/

Publications

NOAA Electronic Navigational Charts (NOAA ENC®) and NOAA Raster Charts (RNC)

NOAA ENCs are Vector files of chart features and available in S-57 format. NOAA ENCs support marine navigation by providing the official Electronic Navigational Chart used in ECDIS and in electronic charting systems. Critical updates are currently released on a weekly basis, but there are plans to accelerate the update cycle to a daily schedule by the end of 2023.
https://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml

Other Significant Information

Starting in 2019, the NOAA Office of Coast Survey, Marine Chart Division (MCD) began the process of rescheming (i.e., redesigning the scheme of) their electronic navigational chart (ENC) suite based on legacy chart extents digitized from paper nautical chart products to a rectangular tiled grid. An additional goal of redesigning the ENC schema was to improve the overall useability of the ENC products by adjusting the scales to standardized values, metrifying depth contour values, and ensuring the data at the junctions of adjacent chart products are edge matched. As of the summer of 2023, the rescheming effort is nearing the quarter-way mark at 23.5% of planned cells released to the public, with plans to accelerate the effort to meet a December 2026 finishing date (Figure 1). This schedule aims at preparing the data for the new S-100 Universal Hydrographic Data Model, a new, modernized hydrographic data standard sanctioned by the International Hydrographic Organization (IHO).

In addition to the rescheming project, MCD is in the process of canceling traditional paper/raster nautical charts to consolidate production efforts on their premiere product line—the NOAA electronic navigational chart suite. This process has passed the half-way mark with approximately 600 out of 1019 traditional nautical charts discontinued.

To support users in need of a paper chart, MCD provides a service to print customized paper charts using current ENC data through the NOAA Custom Chart (NCC) web application. This application is available at https://nauticalcharts.noaa.gov/charts/custom-chart.html. In Version 2.0 released in February of 2023, the NCC has expanded capabilities to allow users to save their charts so they can be recreated when updates to the chart data are released. More enhancements to the application are planned in the future, including improved symbology, labels, and compass rose placement.

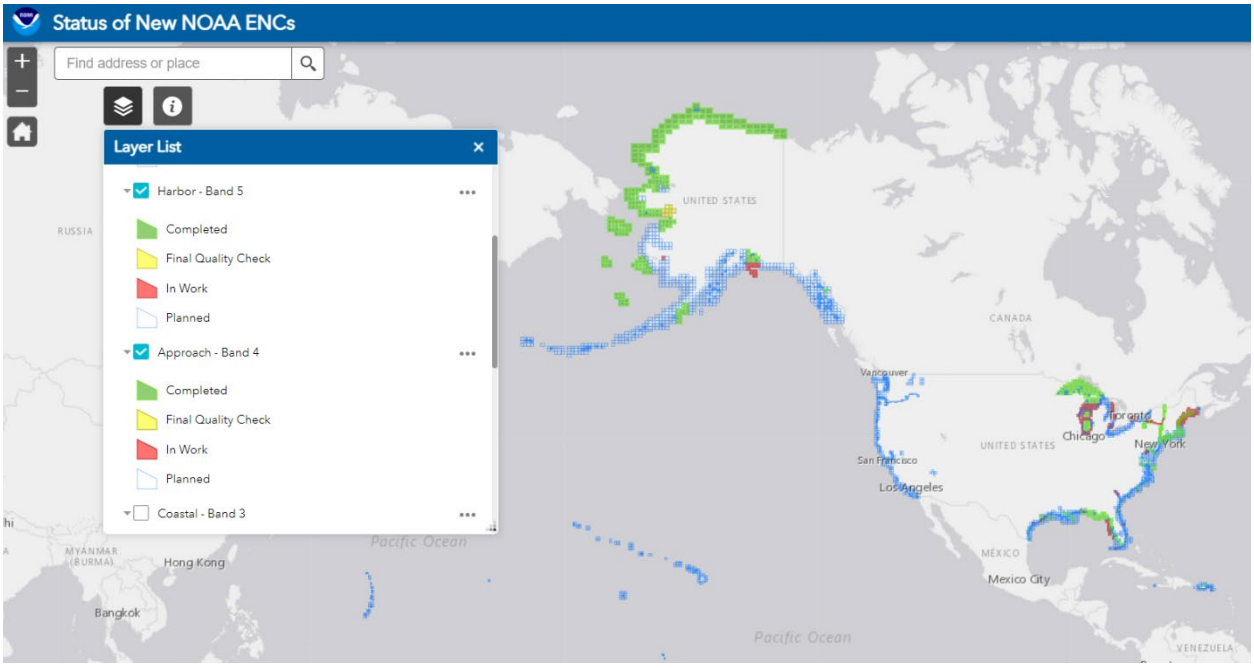


Figure 1. The status of the new NOAA ENCs web application, https://distribution.charts.noaa.gov/ENC/rescheme/

- **Name of Organization:** U.S. Geological Survey Center of Excellence for Geospatial Information Science
- **Acronym:** CEGIS
- **Mission Statement:** The CEGIS mission is to advance geospatial knowledge through cutting-edge research, innovative technologies, and collaborative partnerships. We aim to build a sustainable future by harnessing the power of geospatial information to support informed decision-making, scientific discovery, and environmental stewardship. By providing accessible, dynamic, and intelligent geospatial tools, we seek to empower diverse stakeholders, including governmental agencies, private industries, academia, and the general public, to address global challenges and create resilient communities.
- **Staff:** Six staff and five student developers
- **Website:** cegis.usgs.gov
- **Contact:** Samantha T. Arundel, Acting Director, sarundel@usgs.gov
- **Other Information:** Research Arm of the National Geospatial Program, part of the National Geospatial Directorate

Significant or Signature Events (if applicable)

Geospatial Research Collaboration Meeting

- Annual meeting
- August 1-3, 2023
- Rolla Federal Center, Rolla, MO, USA
- Hybrid meeting
- https://doimspp.sharepoint.com/:x:/r/sites/gs-cegis-annualresearchmeeting/_layouts/15/doc2.aspx?sourcedoc=%7B1D4F5972-070D-465D-B3F6-B1480BD3FFD1%7D&file=CEGIS%20Annual%20Meeting%20Agenda_2023.xlsx&action=default&mobileredirect=true&cid=0a760915-3d41-493e-b1c9-7bf69d81d171
- About 150 attendees

Publications

Usery, E.L., Arundel, S.T., Shavers, E., Stanislawski, L., Thiem, P., & Varanka, D. 2021. GeoAI in the US Geological Survey for topographic mapping. *Transactions in GIS*, 26, 25–40. https://doi.org/10.1111/tgis.12830

Description

CEGIS aims to guide The National Map (TNM) towards an intelligent National Map (INM) in the next five years. The INM will utilize interactive tools to aid scientific discovery and inform decisions. It will be accessible to USGS scientists, Department of the Interior personnel, federal land managers, state and tribal government officials, non-government organizations, and the general public. The INM will support advanced retrievals based on geographic location, layers, feature names, and selection. It will also support mobile, download, and offline access.

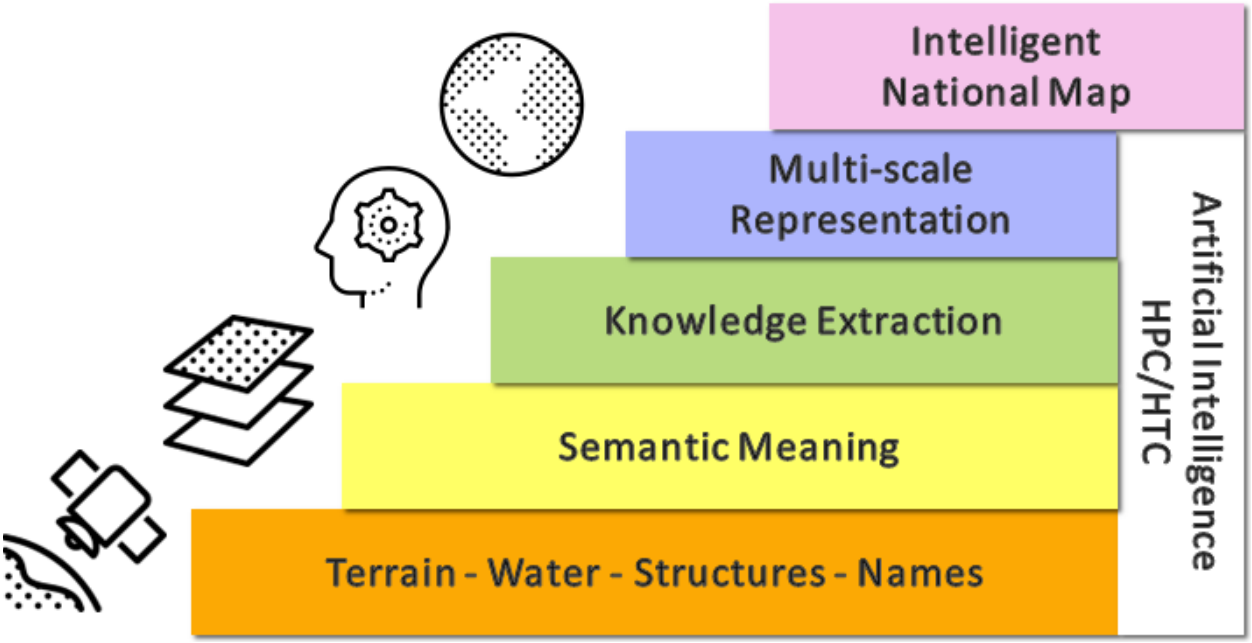


Figure 1. The CEGIS research agenda is to support enhancements to TNM as an intelligent map of the future, developing the competencies needed to realize this vision. An Intelligent Map answers pertinent societal questions related to the natural world.

Memorials

CEGIS Director Dr. E. Lynn Usery passed away on March 22, 2022. See https://icaci.org/obituary-lynn-usery/ for his memorial.

darren sears | worldviews

artistic cartography & geographic inspirations

- **Name of Company/Individual:** Darren Sears
- **Acronym:** N/A
- **Mission Statement:** My artistic watercolor maps are "fractured" into multiple landscapes, capturing and heightening the immersive spatial experiences of ecological edges and islands in ways that traditional aerial views cannot. The compositions convey a sense of ecological fragility, but at the same time suggest a "natural" state of environmental flux and instability that complicates that very idea of preciousness.
- **Employees:** 1
- **Website:** http://www.darrensears.com
- **Contact:** Darren Sears, darren@darrensears.com
- **Social Media:**
    - Facebook: @darrensears.worldviews
    - Instagram: @darrensears.worldviews

Description

My artistic watercolor maps are "fractured" into multiple landscapes inspired by my own photography, conveying immersive spatial experiences of natural environments in ways that individual aerial views cannot (Figures 1 and 2). These multi-faceted compositions accentuate the contrasts (generated by substrate, climate, or land use) that define ecological islands and archipelagos—geographies that feel to me like compressed, empoweringly "knowable" versions of natural spaces and phenomena that we typically think of as larger-than-life. The works are increasingly inspired by real (vs. imaginary) places worldwide, but they are abstract in not only sharpening contrasts but in distorting scales and orientations to reflect my real-world experiences.

The "world-at my-fingertips" sensation originally motivating these maps has recently evolved into a more preservation-minded urge as ecological edges and islands are degraded and obliterated by climate change and other threats. By continuing to emphasize separation and insularity, this emphasis on fragility represents a similar yearning for control—in this case relying on a simplistic idea of nature as historically isolated from change**,** human-caused and not, in time and space. This illusion of stability is only becoming more illusory, and my maps—grasping onto these endangered ecological slivers like precious objects—reveal my difficulty in accepting that reality.

At the same time, however, the maps' immersive quality and fractured structure themselves—unintentionally—begin to express this disparity between the real world and my (and many others') imagination. Unlike typical "scenic" representations of the natural world, the compositions break down the image of nature's spatial and temporal apartness by introducing a dynamic element of ecological flux and human engagement. Yet that feeling of dynamism can take the form of shattering glass, circling back to a quality of fragility reflecting levels of ecological change that are no longer so "natural." Moving forward, the maps will not resolve these tensions but will continue to navigate them.

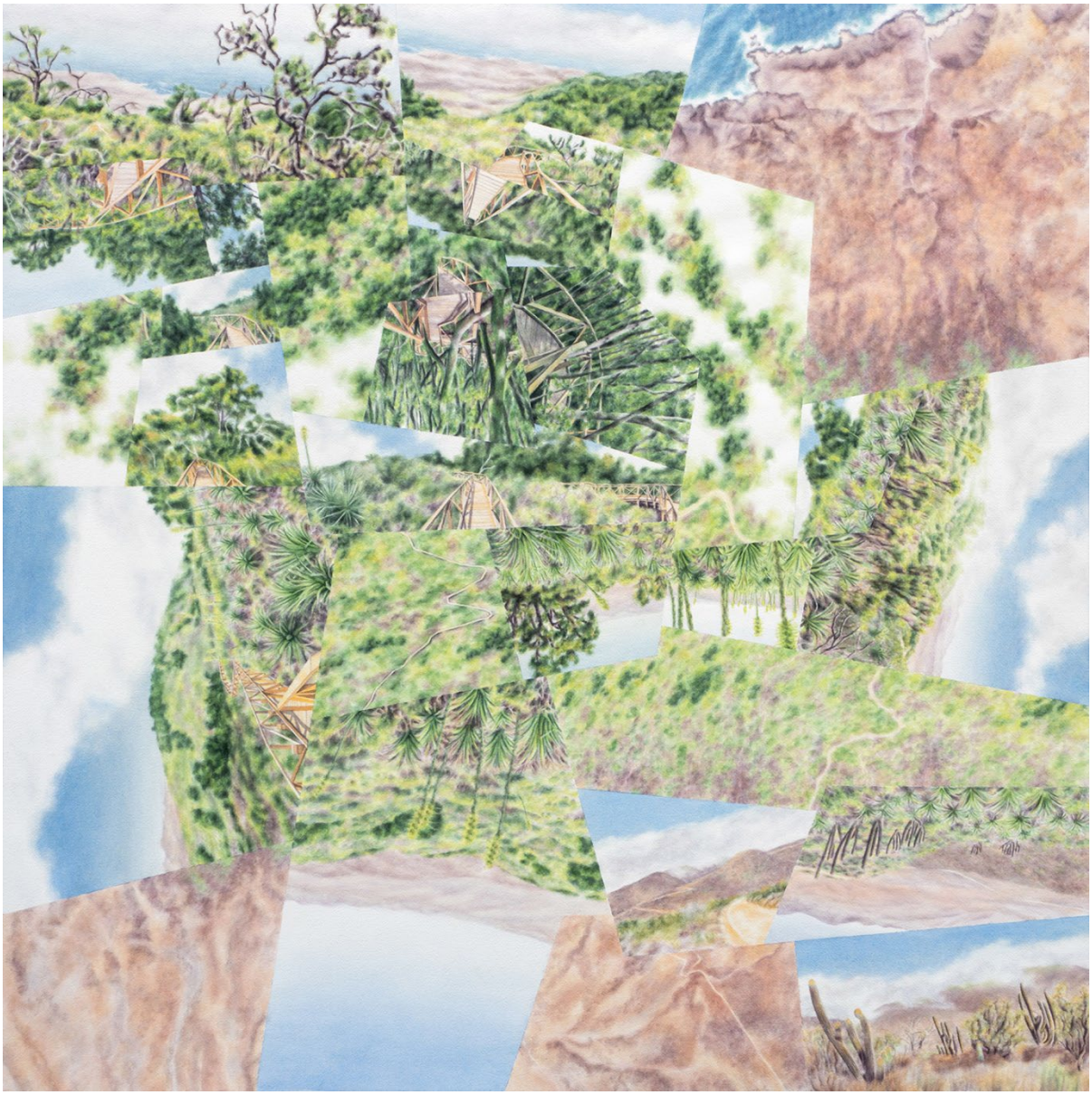


Figure 1. *Oasis*, watercolor on paper, 38” x 38.” Inspired by a combined drive and walk to the center of Bosque Fray Jorge, Chile, a rare and threatened kind of desert oasis fed by coastal fog.

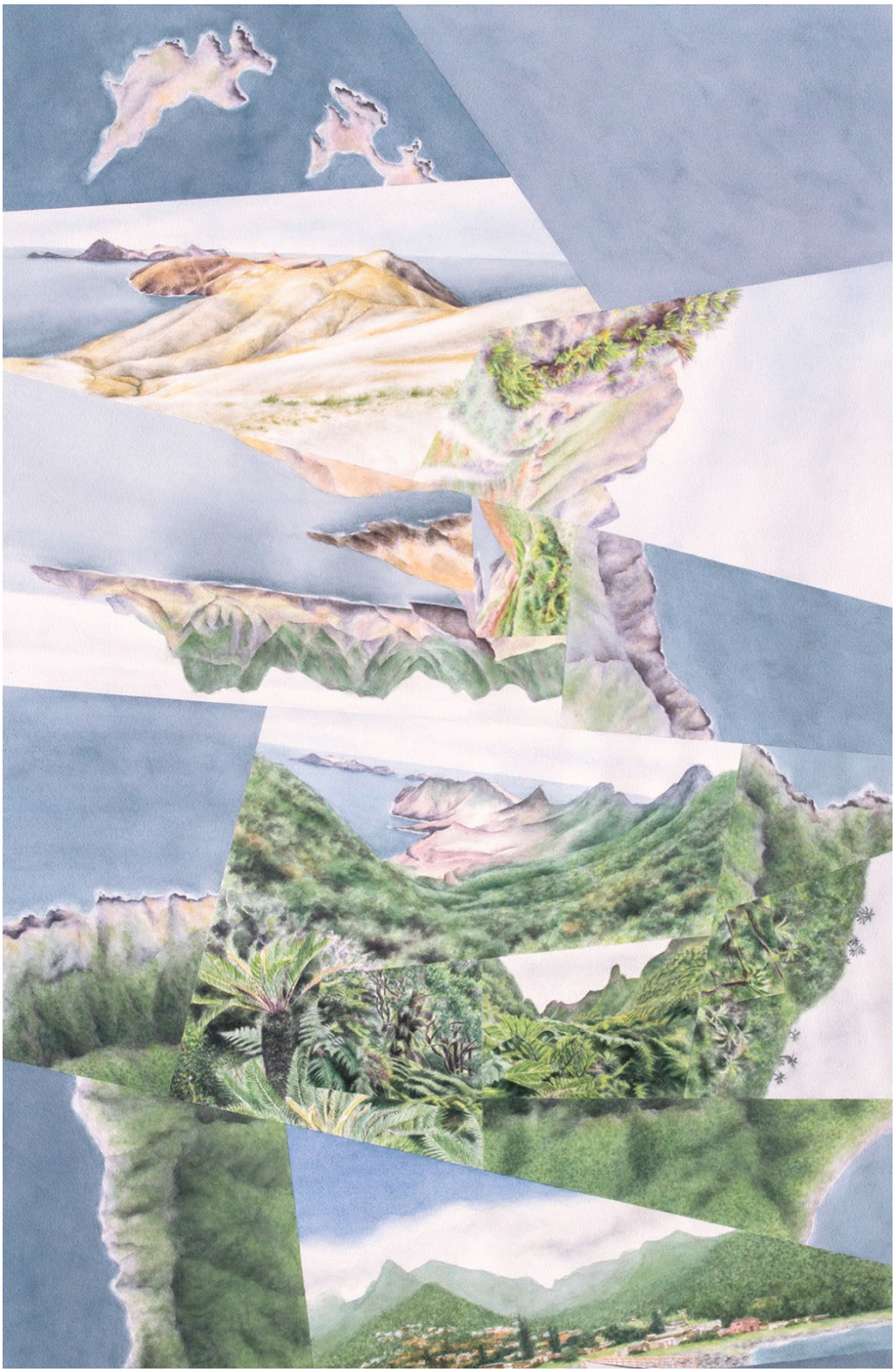


Figure 2. *Mirador*, watercolor on paper, 48” x 28.” Inspired by a hike down the length of Robinson Crusoe Island off the central coast of Chile. Within this “actual” (water-defined) island are smaller-scale islands in the form of endangered pockets of rainforest, restricted by a combination of precipitation patterns and human activity.

- **Name of Organization:** Esri, Inc.
- **Acronym or Short Name:** Esri
- **Mission Statement:** Esri is the global market leader in geographic information system (GIS) software, location intelligence, and mapping. Since 1969, we have supported customers with geographic science and geospatial analytics, what we call The Science of Where. We take a geographic approach to problem-solving, brought to life by modern GIS technology. We are committed to using science and technology to build a sustainable world.
- **Number and Composition of Members or Staff:** More than 5,000 employees from 73 countries
- **Website:** https://www.esri.com/
- **Contact:** https://www.esri.com/en-us/contact
- **Social Media:**
    - Facebook: https://www.facebook.com/esrigis
    - X (SFKA Twitter): https://twitter.com/Esri
    - LinkedIn: https://www.linkedin.com/company/esri
    - Instagram: https://www.instagram.com/esrigram/
    - TikTok: https://www.tiktok.com/@esri_maps
    - YouTube: https://www.youtube.com/user/esritv/

Description

Esri has expanded its cartographic support to include more than the software and guidelines on how to use the ArcGIS platform to produce maps. Software solutions include ArcGIS Online, ArcGIS Pro, and dedicated mapping solutions, such as smart mapping and ArcGIS Maps for Adobe Creative Cloud.

Cartography is also supported by training and education (e.g., software tutorials, Learn ArcGIS lessons, training, MOOCs, videos, technical workshops at conferences, webinars); apps and data (primarily ArcGIS Living Atlas of the World); the Cartography Special Interest Group; and books and other publications (e.g., ArcGIS blog posts, Esri Press and other Esri publications, such as ArcUser, ArcNews and ArcWatch).

Learning Resources

Learning resources include the following:

- Quick-start tutorials focus on essential workflows such as creating projects, symbolizing map layers, and making layouts.
- Tutorial series curate thematically related tutorials, stories, articles, and videos.
- What's New summarizes functionality added at the latest product release.
- ArcGIS Blog includes timely product announcements, how-to articles, and technical updates from Esri product engineers.
- Help is your entry point to the ArcGIS Pro product documentation.
- Esri Academy provides self-study and instructor-led courses, training seminars, learning videos, and more.

- Esri Community is the site where you connect with other users, ask questions, share ideas, and collaborate to solve problems.

Mapping and Charting Industries

Esri mapping and analytics software inspires positive change across industries. For example, National Mapping organizations maintain information using GIS technology to effectively collect, manage, produce, and share base data for their nations.

Significant or Signature Events

Esri User Conference

- Learn, connect, and discover the latest advances in geographic information system (GIS) technology at the Esri User Conference (Esri UC) in San Diego. Join thousands of users from around the globe and discover how you can leverage GIS capabilities to solve problems, build shared understanding, and create the world you want to see.
- Annually in July
- San Diego Convention Center, San Diego. CA
- In-person meeting with select sessions streamed
- https://www.esri.com/en-us/about/events/uc/save-date
- About 20,000 in-person attendees in 2023

Esri Map Galleries

- Tour an expansive collection of beautiful, innovative maps created by our global user community (Figure 1). Each entry showcases the powerful capabilities of GIS technology and tells stories you'll want to explore.
- On-site and virtual
- https://mapgallery.esri.com/map-of-maps

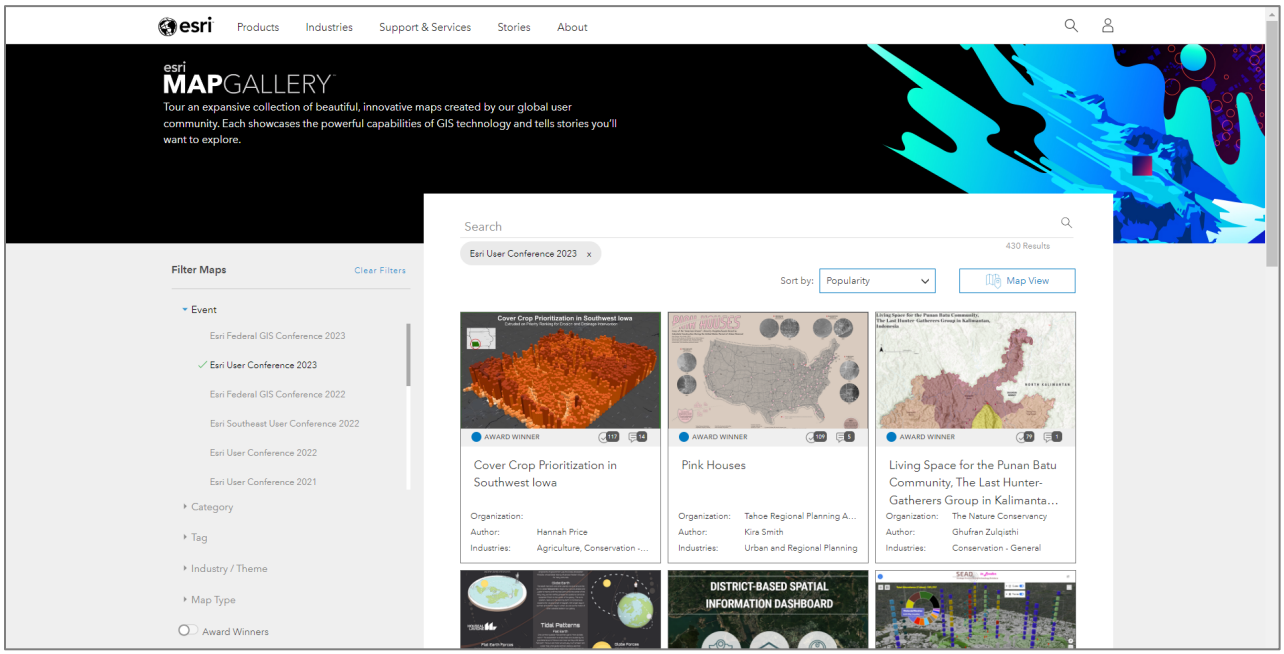


Figure 1. The maps from Esri's events are online for everyone to explore.

- **Name of Organization:** National Geographic Society
- **Acronym:** NGS
- **Mission Statement:** National Geographic Society uses the power of science, exploration, education and storytelling to illuminate and protect the wonder of our world.
- **Website:** https://www.nationalgeographic.org/
- **Contact:** Martin Gamache, Chief Cartographer, mgamache@ngs.org

Significant mapping achievements in 2023

Ukraine: A Year at War

https://education.nationalgeographic.org/resource/ukraine-map-supplement/

This 1:1,000,000 scale map of Ukraine, included in the June 2023 issue of *National Geographic* magazine, continues the National Geographic Society's tradition of depicting conflict in Europe. It introduces a new map policy note for Southeastern Ukraine and illustrates National Geographic's *de facto* approach to cartographic depictions of territorial control. The map shows land cover, road and rail networks, major power plants, border crossings, and topographic relief, along with contextual notes that highlight key elements of the terrain. Delineations mark the estimated maximum extent of Russian

Figure 1. Front of the 2023 National Geographic Society Ukraine map.

advances, territorial claims, and the approximate frontline a calendar year after the full-scale invasion.

Administrative divisions, populated areas, and rivers are labeled using official Ukrainian transliterations of their Ukrainian names, with the exception of Crimea, which features transliterated Russian names.

Graphics and thematic maps in the margins present data about refugees and internally displaced persons, explain Ukraine's vital role as a global breadbasket, and show how the invasion has impacted the production and export of essential crops. This map aims to give readers the geographic literacy necessary to understand this complex, crucially important event.

The reverse side of the 2023 National Geographic map of Ukraine puts the war in geopolitical and historical context (Figure 2). It shows the growth of NATO, former Cold War boundaries, and the memberships of the EU and the post-Soviet CSTO alliance. Text notes address precursor conflicts and explain National Geographic's de facto depictions of disputed areas. Natural gas supplies to the EU are abstracted as arrows that compare prewar averages to reduced flows in the year after the invasion. An illustrated timeline traces the development of the Ukrainian state and its relationship with Russia. We will discuss the challenges of creating a content-heavy oblique-view depiction and of making a map that serves as a stand-alone primer on a complex subject.

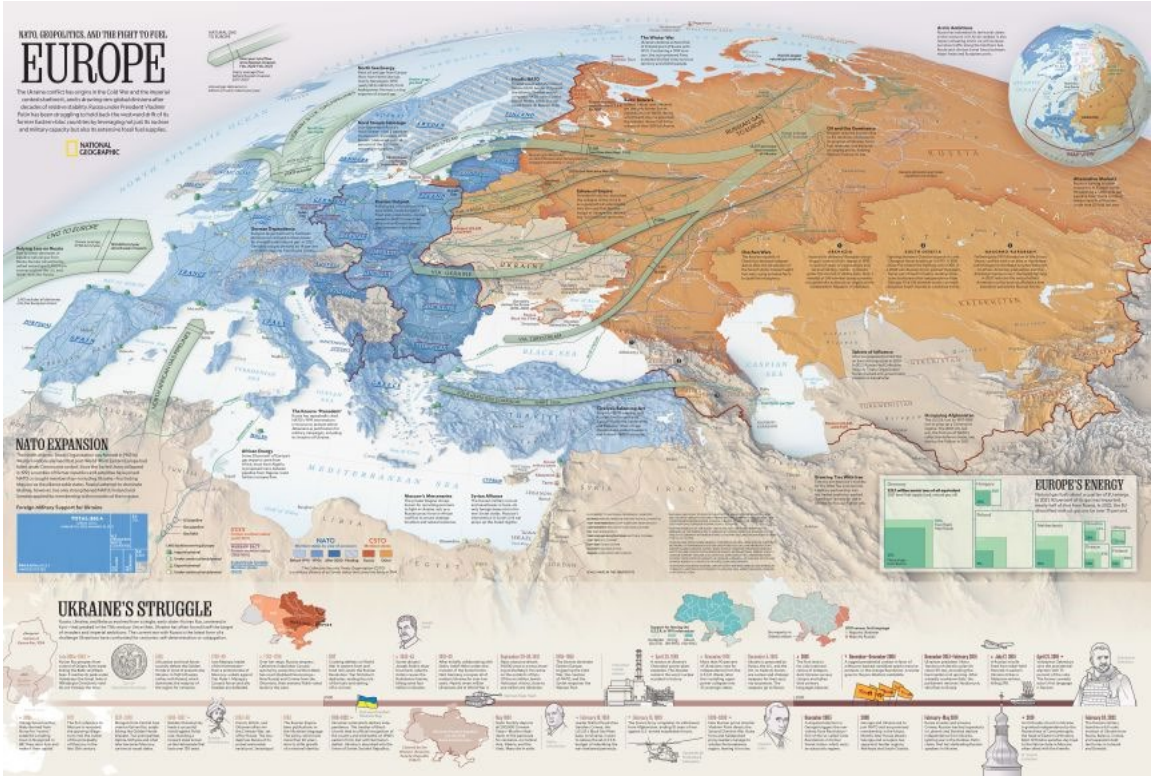


Figure 2. Reverse of the 2023 National Geographic Society Ukraine map.

World Water Map

https://worldwatermap.nationalgeographic.org/

The information presented in the world water map is based on a global model developed at Utrecht University in the Netherlands (Figure 3). Led by National Geographic Explorer Marc Bierkens, this World

Water Map helps us understand where and why water gaps arise, how climate change might aggravate them—and even how they might be managed.

Figure 3. National Geographic Society World Water map.

Defining the Angolan Highland Water Tower

https://storymaps.arcgis.com/stories/ebeca89587c646cd81bc1f4c85f0e393

The AHWT is the southern source of the Congo Basin, the western source of the Zambezi Basin, and the sole water source of the Okavango Basin and Okavango Delta (Figure 4). Approximately 95% of the

Figure 4. National Geographic Society Angolan Highland Water Tower map.

water that flows into the Okavango Delta in Botswana originates from precipitation in the Angolan highlands. The Okavango Delta is formally protected by Botswana and is recognized as a UNESCO World Heritage site and Ramsar Wetland of International Importance. However, the newly defined Angolan Highlands Water Tower lacks any such protections – despite being the source of the Delta.

"The Angolan Highlands Water Tower is not only keystone to the future of southern Africa and its long-term resilience to climate change, but it has profound cultural and spiritual importance. It's called *'Lisima Lya Mwono'* (source of life) in the local Luchaze language, and the people who live here have sustained this landscape through their traditions and knowledge," said Dr. Steve Boyes, National Geographic Explorer and founder of the National Geographic Okavango Wilderness Project. "Now that we've defined the boundaries of Angolan Highlands Water Tower within academic science, we need to protect it, in partnership with communities. An important first step is recognition of the water tower as a Ramsar Wetland of International Importance, and we look forward to securing that designation."

- **Name of Organization:** Treeline Terrains, LLC
- **Name:** Treeline Terrains
- **Mission Statement:** Map your story. Capture the landscape where memories were made in a 3D wood carving, crafted with satellite technology.
- **Staff:** 3 full time staff, 5 part-time interns
- **Website:** https://treelineterrains.com/
- **Contact:** Jacob Freedman, Co-Founder/Director of Mapmaking, jacob@treelineterrains.com
- **Social Media:**
    - https://www.facebook.com/treelineterrains
    - https://www.instagram.com/treelineterrains/
    - https://www.tiktok.com/@treelineterrains?lang=en

Description

Inspired by their shared love of skiing in Vermont, Treeline Terrains founders Jacob, Nathaniel, and Alex searched for a creative way to capture their outdoor winter experiences. Using satellite mapping technology, they brought their idea to the woodshop to create a perfectly accurate 3D model of the mountain. The carving detailed each slope, trail, and descent where the friends had shared many winter days.

Today, Treeline Terrains captures the topography of the places you love in wood-carved models. Each model celebrates place-based experiences, such as a father and son hiking trip in Montana, a beloved family campsite in Maine, or a motorcycle trip in Baja, California. Your carving uniquely captures the place where memories were made.

Our process begins with your story. Using GIS technology, we create a 3D digital rendering that centers on the mountains, trails, roads, and shorelines where your story takes place. That model is sent to our CNC Router, a computer-controlled drill bit, to capture the topographic landscape with perfect accuracy. Where the technology ends is where your piece comes to life. We hand sand and oil each carving to bring out the natural beauty of the wood and add the finishing touches that make it truly yours—the river that runs through your property, the lake where you swim each summer, or a gemstone to mark the location of your home.

We craft each carving in our Monkton, Vermont, workshop. Each work of art marries modern technology with traditional woodworking. Locally sourced cherry, maple, and walnut enhance a sense of place, bringing a piece of nature into your home.

Significant or Signature Events

14th Annual U.S. Association of Blind Athletes Winter Festival, 2023

In partnership with Vermont Adaptive Ski & Sports, Treeline Terrains designed a fully tactile 2-foot x 2-foot 3D map of Vermont's Pico Mountain with hand-painted trails for the 14th Annual U.S. Association of Blind Athletes (USABA) winter festival (Figure 1). This celebration weekend with over 50 attendees took place on 4 February 2023 at Pico Mountain in Killington, Vermont.

Treeline Terrains teamed up with Vermont Adaptive to produce a topographic map of Pico Mountain. The 3D model featured each ski trail for visually impaired athletes to feel, and each trail was hand painted for athletes with partial sight, in an effort to better prepare everyone for a day on the mountain. The wood-carved map is now on display at Vermont Adaptive's Pico facility.

Figure 1. Tactile 3D map of Vermont's Pico Mountain.

Porsche Travel Experience U.S. gift, 2022

Treeline Terrains designed a personalized piece of art with Porsche to commemorate a special trip for their customers. The Porsche Travel Experience was an 8 to 11 day driving excursion for over 65 Porsche owners in the summer/fall of 2022 through various locations in the U.S. Pacific Northwest, U.S. Southwest, and U.S. Northeast. This map of the driving route highlighted the scenic terrain, lakes, and oceans of the surrounding landscape in an accurate 3D wood carving (Figure 2). The map complemented the Porsche-branded gifts and luxury backpack each traveler received by using matching fonts and logos on the custom map art. The map art was lightweight, unique, and durable, so travelers could fit it in their backpack and travel home with it to always remember their trip with Porsche.

Figure 2. A Porsche Travel Experience gift.

Kicking Horse Coffee Topographic Coffee Trays

Treeline Terrains designed custom topographic serving trays for Kicking Horse Coffee's new flagship store, featuring the mountain range in the Canadian Rockies where the store is located in Invermere, Canada (Figure 3). These trays enhance customer experience by bringing the surrounding landscape right to their coffee table, while adding a unique tactile element to the sensory experience of drinking artisanal coffee. These trays were designed in winter 2022 and delivered in summer 2023.

Figure 3. Kicking Horse Coffee topographic coffee tray.

Notable Articles about Treeline Terrains

- Forbes – 3 Strategies For Introducing Your Artisan Business Into The Luxury Market, 9 November 2022
- Vermont 7 Days – Treeline Terrains Marries Art and Tech to Craft 3D Landscapes, 1 December 2021
- WCAX – Made In Vermont: Treeline Terrains, 15 May 2023

Awards We've Designed

Vermont Outdoor Business Alliance (VOBA) Trailblazer Award

The VOBA Trailblazer Award honors the historical and long-lasting contributions of leaders in Vermont's outdoor sector. Recent recipients include Marc Sherman and Mike Donahue, Outdoor Gear Exchange (2022) and Senator Patrick Leahy (2021). https://www.vermontoutdoorbusinessalliance.org/12622-press-release

Southern Vermont Emerging Leaders Award

The Southern Vermont Emerging Leaders Award celebrates young professionals who have shown demonstrated leadership in the community. Treeline Terrains designed custom awards for 18 award winners in 2022 and 2023. https://vermontbiz.com/news/2023/may/26/emerging-leaders-recognized-southern-vermont-economy-summit

Other Significant Initiatives or Information

2023 International Cartographic Exhibition (ICE)

We entered one of our map compilations, Dead Creek Wildlife Management Area (Vermont), in the Maps category of the ICE. The maps in this compilation are displayed in a Vermont Fish & Wildlife visitor center, one of the most highly visited wildlife centers in the state (Figure 4). This touch table helps

visitors get a sense for the local topography and the overall valley that feeds the watershed. A larger map shows the local topography and water of Dead Creek Wildlife Area, and a smaller map zooms out to the valley framed by the Green Mountains and Adirondacks. The maps are carved in maple and cherry hardwoods, with blue epoxy resin for the water and tourmaline gemstone location markers showing the visitor center and popular nearby hiking areas.

Figure 4. Dead Creek Wildlife Management Area (Vermont) touch table.