

# Ian Muehlenhaus, Ph.D.

**Cartography | GIScience | Geoinformatics | Geovisualization**

Principal Product Engineer, Esri | Former Assistant Professor and Graduate Programme Director

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## Research profile

My research asks how maps and GIS interfaces shape what people see, understand, and believe. The work has moved from persuasive cartography and visual rhetoric, through web and interactive map form and pan-scalar navigation, to natural-language GIS and agentic AI. I am particularly interested in what happens when expert cartographic knowledge is embedded in software systems that can create, analyse, critique, and explain geographic information.

Current disciplinary interests: cartography; geographic information science; geoinformatics; geovisualization; interactive and web mapping; map design and rhetoric; spatial user experience; natural-language GIS; AI-assisted cartographic production; provenance and evaluation of AI-produced maps.

### Current research directions

- Open, multilingual natural-language GIS for spatial analysis and mapmaking.
- Multi-agent cartographic systems grounded in open cartographic knowledge graphs and disciplinary bodies of knowledge.
- Open and standardised provenance approaches for AI-produced maps, including transparent records of data, prompts, tools, transformations, and human/agent decisions.

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## Professional and academic appointments

### Principal Product Engineer, Esri, Inc., United States February 2026-present

- Leads product research and design at the intersection of natural-language GIS, agentic AI, geovisualization, and production GIS software.
- Translates user and system-behaviour problems into product requirements, implementation workstreams, and cross-functional development plans; leads product-engineering/developer meetings and presents progress to stakeholders and management.
- Designs system prompts, agent instructions, tool/function descriptions, few-shot examples, test prompts, workflow instructions, evaluations, and knowledge-base / knowledge-graph content for multi-agent GIS systems.
- Manually evaluates AI behaviour and GIS correctness before automation, using known-answer and edge-case testing; documents failures and creates issues/workstreams for correction.

### Senior Product Engineer, Esri, Inc., United States February 2022-February 2026

- Natural-language GIS / generative AI (2025-2026): helped design how ordinary-language requests are interpreted, decomposed, routed among agents and tools, and translated into ordered GIS operations.
- ArcGIS for Microsoft 365 (2023-2025): proposed and spearheaded user-facing GIS and map capabilities; led product design and implementation teams, wrote requirements/workstreams, coordinated developers and stakeholders, and tested completed features. Representative work included Select by Attribute, distance-based filtering, home-extent and zoom controls, bookmarks, and thematic-mapping enhancements.
- ArcGIS Insights (2022-2023): product engineering, feature/workflow design, quality assurance, implementation-team participation, and development of product-education and workflow examples.

### Director of Professional Program Development, Division of Continuing Studies, University of Wisconsin-Madison 2020-2022

- Recruited into a university-wide development role after the rapid growth of the GIS Professional Programs; served as an internal higher-education strategist for new professional graduate offerings.
- Conducted labour-market, competitive, enrolment, and programme-positioning research; developed business/enrolment models; and worked with faculty, deans, and campus stakeholders to move viable programmes through planning and governance.
- Facilitated development of interdisciplinary professional offerings, including work supporting graduate education in psychoactive pharmaceutical investigation/development and broader COVID-era expansion of online and professional education.

## **Director of GIS Professional Programs, Department of Geography, University of Wisconsin-Madison**

2015-2020

- Inherited an approved online GIS master's framework with no developed courses, enrolled students, recruitment system, or marketing infrastructure; built the operating, instructional, recruitment, and advising ecosystem needed to launch and scale it.
- Expanded the portfolio to two master's degrees and two online certificates, reaching approximately 100 students at peak and about US\$1.2 million in annual tuition revenue across programmes under the directorship.
- Led curriculum development, online instructional design, admissions/recruitment, marketing and web copy, student advising, capstone mentoring, budgeting/programme operations, and continuous improvement.
- Led and coordinated approximately 5-7 instructors per semester, 1-2 staff members, 1-2 instructional designers, and course-development contractors; held direct hiring and evaluation responsibilities.

## **Assistant Professor, Integrated Science and Technology, James Madison University, United States**

2014-2015

## **Assistant Professor, Geography and Earth Sciences, University of Wisconsin-La Crosse, United States**

2011-2014

- Taught a four-course-per-semester load in cartography, GIS/geovisualization, and human geography while maintaining an active research programme, securing external/internal research funding, mentoring students, and authoring Web Cartography.

## **GIS Lab Manager and Lecturer, University of Wisconsin-River Falls, United States** 2008-2011

## **Education**

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Ph.D., Geography (Cartography and GIS specialization), University of Minnesota, 2010. Dissertation: Lost in Visualization: Using Content Analysis to Analyze and Compare the Genealogy of Persuasive Maps.

M.Sc., Geography (International Geopolitics / cyber-geopolitics emphasis), The Pennsylvania State University, 2002. Thesis (published as Ian Oas): The Geopolitics of Spatial Dementia: Online Adversaries and U.S. Hegemonic Decline.

B.A., International Studies and Geography, University of Minnesota-Duluth, 1999.

Earlier scholarly work was published under the name Ian Oas.

## **Books**

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Muehlenhaus, I. (2026). Prompt Cartography: Interactive Web Map Design with LLMs. CRC Press. 376 pp.

Muehlenhaus, I. (Ed.). (2019). Geography Today: Concepts, Issues, and Technology. ABC-CLIO. 416 pp. Choice Outstanding Academic Title, 2020.

Muehlenhaus, I. (2014). Web Cartography: Map Design for Interactive and Mobile Devices. CRC Press. 262 pp.

## **Peer-reviewed journal articles**

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Field, K., & Muehlenhaus, I. (2025). On the Ethics of Cartographic Ethics. *The Cartographic Journal*, 61(4), 288-305. <https://doi.org/10.1080/00087041.2025.2479647>

Field, K., & Muehlenhaus, I. (2025). Script for a cartographer's tear. *International Journal of Cartography*, 11(2), 246-255. <https://doi.org/10.1080/23729333.2025.2466126>

Gruget, M., Touya, G., & Muehlenhaus, I. (2025). Exploring the presence and persistence of cartographic anchors in pan-scalar maps. *Spatial Cognition & Computation*, 25(3), 195-227. <https://doi.org/10.1080/13875868.2024.2383419>

Touya, G., Gruget, M., & Muehlenhaus, I. (2023). Where Am I Now? Modelling disorientation in pan-scalar maps. *ISPRS International Journal of Geo-Information*, 12(2), 62. <https://doi.org/10.3390/ijgi12020062>

Gruget, M., Touya, G., & Muehlenhaus, I. (2023). Missing the city for buildings? A critical review of pan-scalar map generalization and design in contemporary zoomable maps. *International Journal of Cartography*, 9(2), 255-285.

Muehlenhaus, I. (2021). Reorienting the narrative: Chapin Jr.'s "Red China" map. *International Journal of Cartography*, 7(2), 171-177.

Jenny, B., Stephen, D. M., Muehlenhaus, I., et al. (2018). Design principles for origin-destination flow maps. *Cartography and Geographic Information Science*, 45(1), 62-75.

Jenny, B., Stephen, D. M., Muehlenhaus, I., et al. (2017). Force-directed layout of origin-destination flow maps. *International Journal of Geographical Information Science*, 31(8), 1521-1540.

Muehlenhaus, I. (2014). Looking at the big picture: Adapting film theory to examine map form, meaning, and aesthetic. *Cartographic Perspectives*, 77, 46-66.

Muehlenhaus, I. (2014). Going viral: The look of online persuasive maps. *Cartographica*, 49(1), 18-34.

- Muehlenhaus, I. (2013). The design and composition of persuasive maps. *Cartography and Geographic Information Science*, 40(5), 401-414.
- Muehlenhaus, I. (2012). If looks could kill: The impact of rhetorical styles in persuasive geocommunication. *The Cartographic Journal*, 49(4), 361-375.
- Muehlenhaus, I. (2011). Another Goode method: How to use quantitative content analysis to study change in thematic map design. *Cartographic Perspectives*, 69, 7-30.
- Muehlenhaus, I. (2011). Genealogy that counts: Using content analysis to explore the history/evolution of persuasive maps. *Cartographica*, 46(1), 28-40.
- Muehlenhaus, I. (2011). From print to mobile mApps: How to take Adobe Illustrator files, add pinch-to-zoom, and put them on Android Market. *Cartographic Perspectives*, 69, 59-70.

## Refereed conference proceedings and published abstracts

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- Muehlenhaus, I. (2025). Inflection Point: Multi-Agent AI and the Future of Cartographic Practice and Knowledge Production. *Abstracts of the International Cartographic Association*, 10, 206. <https://doi.org/10.5194/ica-abs-10-206-2025>
- Gruget, M., Touya, G., Potié, Q., & Muehlenhaus, I. (2024). A methodological inquiry for anchoring pan-scalar maps. *AGILE: GIScience Series*, 5, 27. <https://doi.org/10.5194/agile-giss-5-27-2024>
- Muehlenhaus, I. (2023). Confronting the quantum: Do maps visualize or create spatial reality and truth? *Abstracts of the International Cartographic Association*, 6, 176.
- Touya, G., Lobo, M.-J., Mackaness, W. A., & Muehlenhaus, I. (2021). Please, Help Me! I Am Lost in Zoom. *Proceedings of the International Cartographic Association*, 4, 107. <https://doi.org/10.5194/ica-proc-4-107-2021>
- Muehlenhaus, I. (2019). Banal Cartography: A Critique of Quantitative Content Analysis in Contemporary Cartographic Research. *Abstracts of the International Cartographic Association*, 1, 262. <https://doi.org/10.5194/ica-abs-1-262-2019>

## Book chapters and reference contributions

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- Muehlenhaus, I. (forthcoming). Populist Cartography; or: How We Need to Stop Worrying and Embrace Pulp Cartography. Peer-reviewed book chapter accepted for the forthcoming Springer volume of selected papers from New Zealand GeoCart 2022 and 2024, edited by Antoni Moore.
- Muehlenhaus, I. (2018). Internet Mapping. In A. J. Kent & P. Vujakovic (Eds.), *The Routledge Handbook of Mapping and Cartography* (pp. 375-387). Routledge.
- McMaster, R., & Muehlenhaus, I. (2010). Cartography and Visualization. In J. Bossler (Ed.), *Manual of Geospatial Science and Technology* (2nd ed., pp. 611-632). CRC Press.
- Muehlenhaus, I. (2007). "World Systems Theory (WST)" and "Weapons of Mass Destruction (WMD)." In *Encyclopedia of Environment and Society*. SAGE.
- Oas, I. (2005). Shifting the Iron Curtain of Kantian Peace: NATO Expansion and the Magyars. In C. Flint (Ed.), *The Geography of War and Peace* (pp. 395-414). Oxford University Press.

## Research funding, sponsored work, and fellowships

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- National Science Foundation, Geography and Spatial Sciences Program - US\$81,000. "Flow Maps for Movement Visualization: Digital Generation and Cognitive Evaluation." Principal Investigator: Ian Muehlenhaus, 2014-2016.
- University of Wisconsin-Madison Chancellor's Office Development Grant - US\$500,000. Programme development funding, 2018-2019.
- GIS and Visualization Curriculum Redesign Grant, University of Wisconsin-La Crosse - US\$10,000, 2013.
- International Development Fund Grant, University of Wisconsin-La Crosse - US\$3,250, 2013.
- McColl Research Fellowship, American Geographical Society Library - US\$3,300, 2012.
- Faculty Research Grant, University of Wisconsin-La Crosse - US\$6,832, 2012.
- Graduate Research Partnership Program Grant, University of Minnesota Graduate School - US\$5,000, 2008.
- Zoltai Graduate Fellowship, University of Minnesota Graduate School - US\$6,000, 2005-2006.

## Applied research and geospatial product development

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### Natural-language GIS and agentic AI systems, Esri 2025-present

- Product and system design for natural-language interfaces to GIS, map design, and spatial-analysis functionality.
- Develops system prompts, agent instructions, tool/function descriptions, few-shot examples, workflow instructions, test prompts, evaluations, and knowledge-base / knowledge-graph content for multi-agent, function-calling GIS workflows.
- Researches how natural-language interfaces can reduce dependence on specialist GUI vocabulary while preserving expert spatial reasoning, cartographic judgement, and verifiable GIS operations.

- Researched and prototyped knowledge-graph techniques for improving LLM-agent decision-making in map-design best practices; exploratory R&D, not yet incorporated into production software.

### **Geovisualization and GIS in Microsoft 365, Esri 2023-2025**

- Researched user and competitor workflows; proposed and product-designed GIS/map enhancements for ArcGIS integrations with Excel, SharePoint, and Power BI; wrote requirements and led cross-functional implementation work.
- Led implementation meetings and stakeholder/management progress reviews, then performed release-cycle QA, workflow testing, and feature validation. Role was product engineering and design leadership; production code was written by development teams.

### **Geovisual analytics, ArcGIS Insights, Esri 2022-2023**

- Feature implementation planning, quality assurance, workflow development, product education, and testing for visual/spatial analytics software.

## **Teaching and research supervision**

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Approximately 20 distinct university courses and 500+ students across the academic career, spanning cartography, spatial visualization, GIScience/geovisualization, interactive and web mapping, human geography, Europe/geopolitics, and introductory geography.

### **Graduate and professional GIS education, University of Wisconsin-Madison 2015-2022**

- Taught and developed online graduate curriculum in cartography, GIS, spatial visualization, web/interactive mapping, and applied professional practice.
- Advised more than 40 master's capstone projects; served on four master's thesis committees; co-advised one Ph.D. student at IGN.
- Designed curricula for working professionals and asynchronous/online delivery, emphasising project-based learning, iterative critique, ambiguity, and immediately applicable professional workflows.

### **Undergraduate and graduate teaching University of Minnesota; UW-La Crosse; James Madison University; Metropolitan State University**

- Historical teaching evaluations show consistently strong scores for teaching ability, subject knowledge, critical thinking, and willingness of students to take another course with the instructor.
- Supervised six undergraduate researchers on NSF grant-funded projects and mentored numerous additional course/capstone projects; received a student nomination for UW-La Crosse's Provost's Teaching Excellence Award in 2013.
- Student mentorship outcomes include Mehmet Berker's Great War in East Africa (first place, NACIS Student Map and Poster Competition, 2008) and Zach Bodenner's The Rising Sun: Japanese Imperial Action, 1868-1941 (2011 NACIS Student Dynamic Map Competition, Narrative category).

## **Invited lectures, keynotes, and plenaries**

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- 2017. "Creative Destruction in Professional GIS Education." Plenary presentation, Esri Education Conference, San Diego, California.
- 2016. "The Importance of Design in Visual Communication." Invited lecture, Digital Mapping for Social Good / TechChange.
- 2016. "Why Cartography Still Matters." Keynote, Wisconsin Land Information Association Annual Conference.
- 2015. "Maps as Visual Copy." Invited PechaKucha / closing-banquet talk, North American Cartographic Information Society Annual Meeting, Minneapolis, Minnesota.
- 2014. "Back to the Drawing Board? Web Map Design in an Era of Flat Design." Invited keynote/lecture, University of Minnesota GIS Career Fair.
- 2014. "Maps as Rhetorical Weapons (or: Persuading People to See It Your Way)." Yi-Fu Tuan Lecture Series, University of Wisconsin-Madison.
- 2013. "Effective Geocommunication in an Era of Data Overload." Invited presentation, NASA Goddard Space Flight Center, Greenbelt, Maryland.
- 2012. "The Impact of Rhetorical Design in Geocommunication." CartoTalk Lecture Series, Oregon State University.
- 2008. "Lost in Transformation: Nationalism in Post-Soviet Europe." National Geographic Society, Washington, D.C.

## **Selected conference papers and professional workshops**

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### **2026**

- 19 August 2026. "Doing Prompt Cartography: Practical LLM Workflows for GIS Professionals." Three-hour virtual professional workshop, Wisconsin Land Information Association.

8 September 2026. Facilitator, "Hands-On Experiences in Prompt-based Cartography: From Perception to AI Automation." EuroCarto 2026, Faculty of Science, Masaryk University, Brno, Czech Republic. Joint workshop of the ICA Commissions on Geovisualization and Map Design.

### **Selected recent and historical papers**

2025. "Inflection Point: Multi-Agent AI and the Future of Cartographic Practice and Knowledge Production." 32nd International Cartographic Conference, Vancouver, Canada.
2024. "ChatGPT Map Doctor." New York State Geospatial Summit.
2024. "Thoughts on Cartography and AI." Invited guest lecture, Master's in Cartography seminar, TU Wien, Vienna, Austria, hosted by Professor Georg Gartner.
2023. "Multivariate Analysis with Big Data in ArcGIS Insights." With Linda Beale. Esri User Conference, San Diego, California.
2023. "Introduction to ArcGIS for Microsoft 365." Workshop instructor, Minnesota GIS/LIS Annual Conference.
2022. "Advanced Analysis in ArcGIS Insights." With Linda Beale and Warren Davison. Esri User Conference, San Diego, California.
2019. "Cartography: A Primer." Professional GIS workshop, Wisconsin Land Information Association Annual Conference.
2018. "Words Matter: Copywriting for Spatial Visualization." American Association of Geographers Annual Meeting, New Orleans, Louisiana.
2017. "How to Design Persuasive Maps." Professional GIS workshop, Wisconsin Land Information Association Annual Conference.
2014. "Adapting Theories of Form, Meaning, and Style for Map Research." NACIS Annual Conference, Pittsburgh, Pennsylvania.
2014. "Adapting Film Theory to Analyze Map Narrative, Form, and Aesthetic." Association of American Geographers Annual Meeting, Tampa, Florida.
2013. "Four Rhetorical Styles of Persuasive Geocommunication: A Taxonomy." International Cartographic Conference, Dresden, Germany.

### **Academic leadership and programme development**

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- Built and scaled UW-Madison's professional GIS education portfolio from an approved-but-not-yet-built master's framework to two master's degrees and two online certificates, approximately 100 students at peak, and about US\$1.2 million in annual tuition revenue.
- Led programme strategy, curriculum and instructional design, faculty/staff hiring and coordination, recruitment/marketing, admissions, student advising, capstone supervision, financial/programme operations, and continuous improvement for online graduate GIS education.
- Recruited into UW-Madison's Division of Continuing Studies because of the GIS portfolio's growth; applied market research, competitive analysis, business modelling, stakeholder facilitation, and university-governance knowledge to new professional graduate programmes.

### **Academic service and disciplinary leadership**

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Chair, Commission on Map Design, International Cartographic Association, 2019-present.

Editorial Board Member, Cartographic Perspectives, 2010-present.

Associate Editor, Journal of Maps, 2012-2019.

Director, Board of Directors, Cartography and Geographic Information Society (CaGIS), 2014-2017.

Vice-Chair, Chair, and Past-Chair, Cartography Specialty Group, Association of American Geographers, 2011-2015.

Board Member, McFarland Education Foundation, 2019-2020.

### **Peer-review service**

Approximately 50 manuscript and book reviews across outlets including Applied Geography, Annals of the AAG, Political Geography, Journal of Maps, Cartographica, International Journal of Geographical Information Science, Journal of Spatial Science, Future Internet, CRC Press book proposals, and other scholarly/editorial reviews.

### **Honours and awards**

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Choice Outstanding Academic Title Award, 2020 - Geography Today: Concepts, Issues, and Technology.

Best Presentation Award, Wisconsin Land Information Association, 2014 - "Map Design for Maximum Impact."

Student nomination, Provost's Teaching Excellence Award, University of Wisconsin-La Crosse, 2013.

Ralph Hall Brown Award, Best Graduate Student Publication in Geography, University of Minnesota, 2005.