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Editorial

Editorial Commentary on the *IJGI* Special Issue "Mapping Indigenous Knowledge in the Digital Age"

Romola V. Thumbadoo * and D. R. Fraser Taylor

Geomatics and Cartographic Research Centre, Department of Geography and Environmental Studies, Carleton University, 1125 Colonel By Drive, Ottawa, ON K1S 5B6, Canada; frasertaylor@cunet.carleton.ca
* Correspondence: romolathumbadoo@cmail.carleton.ca

Indigenous mapping is rapidly entering the domain of cartography, and digital technology is facilitating the engagement of communities, particularly Indigenous communities, in order to map their own locational stories, histories, cultural heritage, and environmental and political priorities. Indigenous knowledge is increasingly becoming recognized as a parallel and equal knowledge system, and the holistic nature of Indigenous mapping, incorporating performance, process, product, and positionality, as well as tangible and intangible heritage, is transforming the conceptual parameters of traditional mapping.

Multimodal and multisensory online maps combine the latest multimedia and telecommunications technology to examine data and support qualitative and quantitative research, as well as presenting and storing a wide range of temporal/spatial information and archival materials in innovative interactive storytelling formats. Additionally, researchers are now examining legal and ethical issues, data sharing, and standards issues concerning what is described as traditional, informal, or community knowledge. There are many groundbreaking mapping initiatives underway with Indigenous peoples across the globe.

This Special Issue explores Indigenous engagement with geo-information in contemporary cartography. Its papers demonstrate the importance of non-technical issues to both researchers and communities, and their work demonstrates how critical it is to consider the new dimensions in spatial representation that Indigenous thinking introduces.

A synopsis of a key themes examined in the individual research papers follows, grouped by area of research (South America, United States and Canada).

A Cybercartographic Atlas of the Sky: Cybercartography, Interdisciplinary and Collaborative Work among the Pa Ipai Indigenous Families from Baja California, Mexico (Dominguez) [1]:

This paper examines the pre-existent challenges and distrust experienced in cross cultural and knowledge exchange with Pa Ipai Indigenous Peoples in Mexico; the consequences of a history of deterritorialism, land appropriation, violence and extractive research practices by anthropologists; and the subsequent use of cybercartography as an interdisciplinary methodology to build trust and integrate knowledge in the face of the hyper-fragmentation of current practices in some scientific research. Indigenous mapping includes different semiotic systems: linguistic, visual, spatial and verbal. These dimensions can be understood as multimodal tools, and on the cybercartographic platform, a phenomenon known as syncretism in semiotics occurred in the research: when the names of the stars, songs, narratives, drawings and photographs were recorded on the map, a variety of the different semiotic systems were presented. Consistent with emerging research on cybercartography, the paper notes that it comprises a set of tools and concepts that combine participatory mapping with geographic information systems and multimedia, wherein process is as important as (if not more important than) product. It is also a type of research where problems and problem-solving proposals arise through dialogue between different actors and perspectives, in particular between academics and Indigenous peoples, and it suggests interdisciplinary and collaborative research can become convergent. Here,

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engagement with young people, already entrenched in the technology of the social media era, and multi-level relationship building with community elders in the creation of a cyber-cartographic atlas on digital technology, is viewed as being located between, through and beyond particular disciplines in a reality composed of multiple levels and dimensions. In this research, we learn that the deployment of spatial and mnemonic skills in traditional Indigenous mapping integrates celestial, social, philosophical, and cosmological elements; this deepened our understanding of heritage, supports youth and community empowerment and sustainability, and adds new research dimensions to international academic collaborations, GIS and multimedia work.

Indigenous Mapping for Integrating Traditional Knowledge to Enhance Community-Based Vegetation Management and Conservation: The Kumeyaay Basket Weavers of San José de la Zorra, México Andrade-Sánchez et al. [2]**:**

As one of several trans-disciplinary initiatives explored in this publication, this paper explores innovative tools for a participatory methodological approach based on the Indigenous community mapping of the Kumeyaay people. This facilitated the empowerment of the community and the integration of local and scientific knowledge to create vegetation management and sustainable conservation actions to support basketmaking. Therefore, this successfully allowed for a plant population analysis and adequate decision-making regarding natural resources management and conservation. An interdisciplinary group of teachers, students and researchers (linked to the master's program in Arid Ecosystems Management (MEZA, for its initials in Spanish) at the Autonomous University of Baja, California) engaged in an iterative, systematic, dynamic knowledge dialogue feedback practice comprised of six phases (preparation, information, training, research, analysis and management) to achieve the objective of building bridges between traditional and scientific knowledge by incorporating mapping, exaltation, analysis, and management and conservation actions.

Participatory Mapping as a Didactic and Auxiliary Tool for Learning Community Integration, Technology Transference, and Natural Resource Management (Eaton et al.) [3]**:**

Further insights and methodologies for participatory mapping with the Kumeyaay community are presented in this paper, emphasizing the critical importance of relationally and respect in the interdisciplinary engagement in Indigenous mapping and conservation. The knowledge dialogue practice already referenced was strengthened by the sustained construction of a learning community approach to ensure participatory data compilation and analysis. In the mapping sessions, instructors and community members jointly engaged in learning, such that the community learned and contributed their knowledge to the development of thematic maps, while the instructors learned and integrated aspects of community culture, including linguistic and cultural expression. Recognizing the diversity and importance of the knowledge of all participants contributed to strengthening collaboration, community self-evaluation and empowerment. The knowledge dialogue exchanges led to (i) concrete results in plant conservation in an arid environment, (ii) the identification and resolution of water/health issues, and (iii) technology transfer (GPS for mapping and field data collection; the creation of printed and digital on-line maps and community cyber atlas story maps). These findings collectively contribute to economic, social, cultural, educational and environmental strengthening.

Traditional Communities and Mental Maps: Dialogues between Local Knowledge and Cartography from the Socioenvironmental Atlas of Lençóis Maranhenses, Brazil (Filho et al.) [4]:

Commencing with the premise that the "map" has always been used to represent inhabited space, communicate, and display paths and routes travelled, researchers note that there are multiple knowledge streams to mapping. While developments in cartographic methods and spatial representations, such as geospatial data sets available in web server maps, have made it possible to expand current mapping systems and trends, the mapping knowledge of local communities, gleaned from Indigenous roots, is critical for survival in a unique geophysical dune zone with extreme physical, geographic and

climatic contrasts, particularly in times of economic diversity, emerging tourism and socio-economic transformation. Researchers deem knowledge sharing as mutually beneficial and scrutinize a sophisticated native guidance (mapping) system, including sensory, memory, ephemeral, cosmic, elemental, sequential toponym signifiers. Cybercartography is operationalized to superimpose geospatial data from different sources and formats on GIS to make spatial relationships explicit and to make interdependencies among geographic phenomena, including Indigenous peoples, comprehensible in geographic analysis, i.e., to unite scientific geo-environmental data and Indigenous mental representations, to provide a comprehensive view of geographical, environmental and social conditions. It is suggested that such cartography can serve as an instrument of planning, understanding and action, both to safeguard the rights of the local residents and in the handling and management of natural resources. It also questions the extent that local communities can engage with the technology for their own benefit.

(Of) Indigenous Maps in the Amazon: For a Decolonial Cartography (Breda) [5]:

Breda examines Indigenous mapping through the lens of decolonial cartography, noting distinctions between the mappings of Indigenous lands, mappings with Indigenous participation, and mappings made by Indigenous people, resulting from distinct cartographic intentions, mapping motives, and representations of spatiality. Her research (re)positions Indigenous peoples as cartographer subjects who possess and produce cartographic/geographic knowledge and questions the Eurocentric legacy of official/academic cartography. Further, she identifies the need to destabilize colonial mapping and pragmatism in order to expand beyond Cartesian knowledge/power conventions and the limitations of myopia via cultural exchange. This trajectory leads to a deeper understanding of the semiotic dimensions of Indigenous mapping, including astronomical knowledge in the linguistic, visual, spatial and verbal mapping practices of a community encoded in history; the architecture of houses; and the organization of villages in material artifacts such as basketry. This requires an expansion of the map concept beyond that graphed in paper. Furthermore, she cautions the motivations of participatory Indigenous mapping, and advocates for an alertness to the originality and authenticity of Indigenous mapping via the cognizant rootedness of colonial pasts in cartography.

Automated Mapping of Historical Native American Land Allotments at the Standing Rock Sioux Reservation Using Geographic Information Systems (Meisel et al.) [6]**:**

Noting that the General Allotment Act of 1887 established the legal basis for the United States to allot individual parcels of tribal land to individual tribal members and sell off remaining "surplus" land, this paper describes the original processes involved in mapping these historical allotments and demonstrates the use of evolving GIS technology to create a custom tool that can take information from tabular-based land descriptions and digital Public Land Survey databases to automatically generate spatial and attribute data of the land parcels. It is argued that the digital allotment mapping using GIS is critical because it provides the cartographic visualization and spatio-analytical capabilities necessary for exploring both the patterns and processes of allotments that are important not only for historical analysis but for investigating and understanding subsequent events and impacts down to the present. This innovative GIS tool was used to auto-map over 99.1 percent of attired lands on the Standing Rock Sioux Reservation and demonstrates its capacity to speedily auto-map other reservations using publicly available spatial databases and land allotment data.

Art and Argument: Indigitization of a Kiowa Historical Map for Teaching and Research (Palmer et al.) [7]**:**

In this paper, an Indigital framework is presented as a way of blending Indigenous knowledge systems with computerized geospatial/GIS systems to support undergraduate education. Here, a particularly historical Kiowa map, created in 1895 by Chál-ko-gái, inclusive of place names and mapped land features and now digitalized, serves to bridge and decolonize current technoscience as students experiment with Indigenous languages, storytelling, symbols, song, dance, calendars or other representations within digital com-

puter environments to examine and interpret them from historical/contemporary angles. Points on a map become sites for storytelling and analysis, regarding, for example, cultural information, Indigenous ideas, linguistic and semiotic data, pictorial codes, kinship relationships, land allotments etc. Recognizing that all knowledge and information systems change when they become mobile and encounter other people, materials and ideas, the paper argues for the acceptance of multiplicity, reciprocity and bridge building between Indigenous and scientific knowledge, asserting the assumption of ideas of shared power, networking, assemblages, decentralization, trust and collective responsibility. The blended knowledge emergent from such spaces of encounter and exchange presents as an Indigital construct, and Indigenous materials, such as historical maps, are brought back to life and reimagined in university classrooms using digital devices. Indigenous knowledge systems and digital technologies are deemed potentially combinable where the convergent capabilities of the latter interface with the creativity and intent of the student. For example, this entails the transformation of particular information into attribute data, the digitization of historical features as vector models, and the deployment of new coordinate and projection ideas in order to bridge incommensurability and extend counter-mapping and decolonization.

The Importance of Indigenous Cartography and Toponymy to Historical Land Tenure and Contributions to Euro/American/Canadian Cartography (Cole and Hart) [8]:

Here, in addition to a chronological examination of historic and contemporary maps, map-related materials, digitized maps and explorers' logs—as well as mapped examples of Native toponymy and territories downloaded from numerous First Nation, tribal, state, provincial, national, university and museum archives and libraries—the researchers affirm that many Indigenous residents were very spatially cognizant of their own lands, as well as neighboring nations' lands, overlaps between groups, hunting territories, populations, and trade networks. They note that, from the start of colonial explorations in North America, European mapmakers relied on Indigenous informants, and there were locations and related information that Indigenous peoples did not reveal. Their paper discusses the relevance of the documentation of toponymy and name-glyphs, and examines contemporary Indigenous mapping in the case of the Sinixt Tribe, who were declared extinct in 1956, but who by 2021, in part via mapping evidence, were affirmed in court as not extinct and with constitutionally protected rights. The combination of historical maps and modern GIS technology is viewed as a means for remapping traditional territories, and supporting the recognition of land rights and access to sacred sites, hunting and fishing.

Mapping Inuinnaqtun: The Role of Digital Technology in the Revival of Traditional Inuit Knowledge Ecosystems (Griebel and Keith) [9]:

This paper examines the development of a digital mapping program to document the Inuinnaqtun ecosystem evident in traditional forms of engagement between Inuinnait people, language and land. The authors also aimed to facilitate the continued circulation of knowledge that underlies these relationships, while critically questioning digital technology's ability to represent Inuinnaqtun ontology and exploring the role it can play in facilitating the local relocation of knowledge, objects and relationships dispersed into global contexts. After centuries of geographical isolation and cultural insularity, the Inuinnait of the Central Canadian Arctic transitioned, post-European contact, from cultural synchronicity with a specific environment and ecosystem, including physical engagement, language, beliefs and spirituality attuned to the natural world, to relocation from the rural to urban areas by the mid-1960s with a rapid shift to new materials, technologies, and worldviews. The implications of this post-contact unravelling of the social fabric, leading to inevitable collapse, was already noted in the 1920s. This paper explores the challenges (assimilation, appropriation) and opportunities that digital technology presents to mobilize Inuinnait ecosystems through the preservation and renewal of knowledge, culture, language, heritage. It discusses digital innovations in a Place Names, Thule and Knowledge Bank Atlas project that involves digital reclamation, repository development and renewal in rich detail.

Mapping for Awareness of Indigenous Stories (Pyne et al.) [10]:
This article draws on Joseph Kerski's identification of five converging global trends (geo-awareness, geo-enablement, geotechnologies, citizen science, and storytelling) that contribute to the increased relevance of geography in education and society. It examines the spatial perspectives, geotechnologies and digital pedagogy in research and teaching linked to working with students in Italy and Canada, with a particular focus on the analysis of sketch mapping, from interviews with surviving attendees of Canadian Indigenous Residential School, incorporated into the Residential Schools Land Memory (Cybercartogaphic) Atlas. Emerging scholars reflect on sketch mapping undertaken on two primary map-based content management systems, (Nunaliit Cybecartographic Atlas Framework and MEME Multimedia Emergent Mapping for Education) to draw attention to the importance of intercultural literacy and to achieve intercultural reconciliation and geo-, carto- and metaliteracy, (metaliteracy being a concept that refers to the knowledge capacity across disciplinary and other domains). It is suggested that instead of the traditional lecture followed by applied learning, consistent with information acquisition, multimedia learning should be employed as an interactive activity where knowledge is personally constructed and critically reflected on by the learner; this approach to spatial thinking helps to improve surface power relationships and structure problems, seeking answers and expressing solutions within new parameters of critical cartography.

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