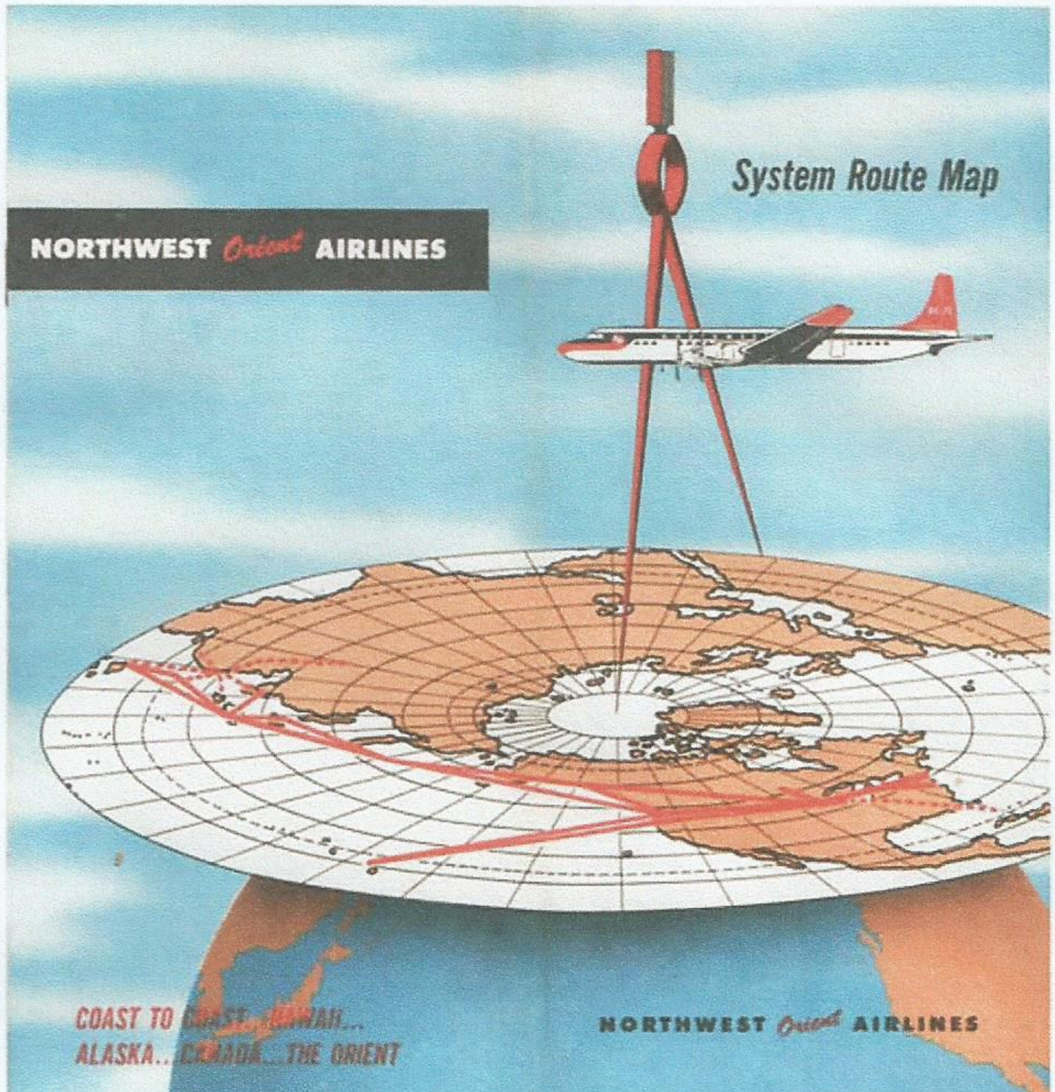
THE HISTORY OF CARTOGRAPHY



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Cartography in the Twentieth Century

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can Society for Photogrammetry and Remote Sensing (ASPRS). Auto-Cartos 9, 10, and 11 were held in Baltimore, about thirty miles north of Washington, D.C., but not far from the center of federal mapping operations, and Auto-Cartos 11 through 13 were convened in Minneapolis (1993), Charlotte (1995), and Seattle (1997). The Auto-Carto label had lost luster by the early 1990s, when cartography and geographic information systems (GIS) were undeniably "auto," and most of the Auto-Carto meetings during the 1990s were additions to a regular ACSM/ASPRS meeting, albeit with a separate program and an extra registration fee. (A decade and a half later, the Cartography and Geographic Information Society, which split off from the ACSM in 2004, revived the brand by holding the 2014 AutoCarto International Symposium on Automated Cartography in Pittsburg.)

Auto-Carto attracted presenters and participants from outside North America, principally from the British Isles, where the organizers of Auto Carto London, who borrowed the brand in 1986, drew large numbers of presenters from North America and Continental Europe. By contrast, the first and fifth European GIS (EGIS) conferences, held in Amsterdam in 1990 and Paris in 1994, had a distinctively European audience, with comparatively few North Americans (Rhind 1998, 302). Auto Carto London was a more ambitious but less durable venture than the Euro-Carto conferences, initiated by David P. Bickmore, founder of the Experimental Cartography Unit at the Royal College of Art, and convened at Oxford in 1982, Oslo in 1983, Graz in 1984, Frankfurt am Main in 1985, Paris in 1986, Brno in 1987, Mallorca in 1990, Warsaw in 1991, Oxford again in 1992, Kiruna in 1993, Copenhagen in 1994, and Ispra in 1995. By the late 1990s cartographic conferences had become frequent worldwide because of enterprising national organizing committees as well as the International Cartographic Association and the United Nations, which sponsored regional cartographic conferences in Africa and Asia.

This proliferation of conferences on computer-aided cartography (and later, on GIS) is apparent in the success of the biennial International Spatial Data Handling Symposia, initiated in Zurich in 1984, and the GIS/LIS series—LIS means land information systems—held annually between 1987 and 1998 (Samborski 2008). Other groups with agendas related to computer-aided cartography met regularly in the 1980s and 1990s; particularly noteworthy are AM/FM (Automated Mapping/Facilities Management) International and ACM SIGGRAPH, the Association for Computing Machinery's special interest group concerned with graphics.

Although the computer-aided mapping conferences of the 1970s and 1980s were distinctive in their impact on the emerging technology, they had several noteworthy precursors, including the twice-yearly meetings of the ACSM and the ASPRS, the yearly meetings of the Urban and Regional Information Systems Association (URISA), and the International Geographical Union's Commission on Geographical Information and Processing, active for twenty years, starting in 1968, under the direction of Roger F. Tomlinson (Foresman 1998).

The most prominent forebear was the SYMAP training conference held at Harvard University's Laboratory for Computer Graphics on 8–19 May 1967 (Horton and Tiedemann 1967). From 1977 into the late 1980s the Harvard laboratory held its own cartographic conferences and related symposia, which focused on the concerns of users, who were more numerous (and collectively more lucrative) than researchers. Attesting to the value of a large audience of software users, the most prominent successor to Auto-Carto is the annual ESRI User Conference, initiated in 1981 and held in San Diego, California, about 100 miles from company headquarters in Redlands.

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SEE ALSO: *International Journal for Geographical Information Systems/Science*; Journals, Cartographic; Societies, Cartographic; Societies, Geographical: Geographical Societies in Canada and the United States; Societies, Map Librarianship; Societies, Photogrammetric and Remote Sensing

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Conferences on Computer-Aided Mapping in Latin America. The widespread diffusion of digital mapping in Latin America is closely linked to the introduction of geographic information systems (GIS) to the continent in 1987, when the first Latin American conference on computers in geography, now known as Conferencia Iberoamericana de Sistemas de Información Geográfica (CONFIBSIG), took place at the Universidad Nacional de Costa Rica, under the auspices of the International Geographical Union. This meeting triggered the transfer of GIS technology to the countries of the region, which, as figure 247 shows, had been lagging behind the more developed world. Twenty-three years had elapsed between the emergence of the Canada Geographic Information System (CGIS), arguably the first GIS, in 1964, and the first donation of GIS software to academic insti-

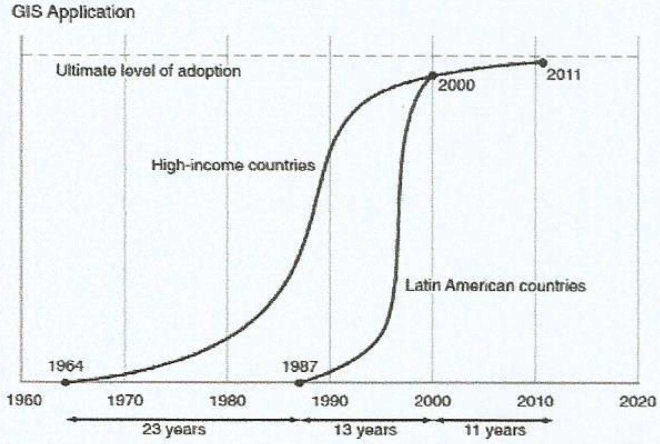

FIG. 247. CUMULATIVE FREQUENCY CHART COMPARING THE RELATIVELY EARLY ADOPTION OF GIS TECHNOLOGY BY HIGHER-INCOME WESTERN COUNTRIES WITH ITS LAGGING ADOPTION IN LATIN AMERICA. Vertical axis represents the proportion of adoptions as the adoption rate converged on an ultimate level. Intersection of the two curves shows that Latin American countries caught up with the West around 2000.
After Gustavo D. Buzai, *La exploración geodigital* (Buenos Aires: Lugar Editorial, 2000), 12.

tutions in Latin America in 1987, when Ohio State University offered its OSU MAP-for-the-PC map analysis package to several Latin American universities. Because of accelerated adoption during the 1990s, by the end of the century Latin America had almost attained the level of sophistication in geospatial hardware and software common throughout the global north.

The short history of GIS and digital mapping in Latin America is best reflected by the increasing maturity of technical and scientific presentations and vendor exhibits at the biennial CONFIBSIG as well as the meeting's diverse venues (table 13). Unlike those in North America, all of these meetings were hosted by universities.

Major Latin American academic and government institutions involved in map production participated in CONFIBSIG. The resulting publications reflect two broad themes, each encompassing slightly more than a decade. From 1987 to 1999, a period of accelerated adoption, technical papers focused on the implementation of hardware and software as well as the training of technical and professional workers. By contrast, from 2000 to 2011, CONFIBSIG publications reflect a shift toward a broadened range of applications and a growing use of mapping software. During this period, Brazil emerged as a leading regional developer of software and also achieved prominence for its undergraduate and graduate programs in GIS.

National meetings on GIS emerged in the 1990s, most notably the Simposio Argentino de Sistemas de Información Geográfica (1990); the Simposio Brasileiro de

TABLE 13. Locations of CONFIBSIG biennial conferences

1987	Universidad Nacional de Costa Rica, San José
1989	Universidad de Los Andes, Mérida, Venezuela
1991	Pontificia Universidad Católica de Chile, Viña del Mar
1993	Universidade de São Paulo, Brazil
1995	Universidad Nacional de Cuyo, Mendoza, Argentina
1997	Universidad Nacional Mayor de San Marcos, Lima, Peru
1999	Universidad de Los Andes, Mérida, Venezuela
2001	Centro Universitario La Salle, Porto Alegre, Brazil
2003	Universidad de Extremadura, Cáceres, Spain
2005	Universidad de Puerto Rico, San Juan
2007	Universidad Nacional de Luján, Buenos Aires, Argentina
2009	Universidad Nacional de Costa Rica, Heredia
2011	Universidad Autónoma del Estado de México, Toluca
2013	Universidad Nacional Autónoma de Honduras, Tegucigalpa
2015	Pontificia Universidad Católica de Valparaiso, Chile [planned]

Buzai and Robinson 2010, 13.

Geoprocessamento (1990–97); the GIS Brazil conference (1994–2004); GEO Brazil (2000–2010); and the Semana Geomática, in Colombia (2005–9). GIS Day, supported by local and regional offices of Environmental Systems Research Institute (ESRI) around the world, also was adopted in Latin America.

Like other cartographic conferences, these meetings typically discussed and adopted resolutions on professional priorities. Until 2000 these conference resolutions were relatively specific and focused mainly on systems operation, but after century's end they became more general with a focus on increased cooperation to promote the diffusion and application of GIS within Latin America.

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SEE ALSO: *International Journal for Geographical Information Systems/Science*; Journals, Cartographic; Societies, Cartographic; Societies, Map Librarianship; Societies, Photogrammetric and Remote Sensing

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Electronic Map. See Map: Electronic Map

Emergency Planning. Population movement from rural areas into cities during the twentieth century created a need for disaster planning by national, regional, and local governments. The resulting field of emergency management has been defined by homeland security expert Claire B. Rubin as "the management of the governmental and nongovernmental preparedness and response at federal, state, and local levels, including non-governmental organizations (NGOs) to unplanned events that affect public health and safety and that destroy property" (Rubin and Colle 2005, 2). Typically framed as a sequence of four key phases—prevention, preparedness, response, and recovery—emergency management also includes mitigation efforts to reduce the severity of an extreme event as well as to make recovery more rapid and effective. Although this entry focuses on emergency planning in the United States, the principles and products discussed can be found throughout the world, albeit more commonly in economically advanced nations.

Planning evacuations or otherwise shielding citizens from extreme natural events, technological hazards, or terrorist attacks is impossible without maps. Key emergency planning tasks that depend upon maps include delimitation of the affected area; coordination among local, state, and federal officials; communication among responding agencies; evacuation and sheltering, with appropriate attention to schools, hospitals, nursing homes, and other special-needs facilities; modeling the potential impact of geographic phenomena such as earthquakes, severe coastal storms, and nuclear accidents; positioning supplies and other resources; law enforcement communications; and risk communication with the public. In mitigating or responding to a disaster, any maps held by local governments, from road maps to sewer system diagrams, may prove useful (Dymon 1994). Private-sector data, most notably the site plans of large industrial plants using potentially explosive materials and the facilities maps of gas, electric, and telecommunications companies, can also be useful.

At the turn of the twentieth century, the fire insurance map was the most focused cartographic approach to disaster planning. Compiled principally for use by insurance underwriters in distant cities, fire insurance maps were city plans drawn at scales of 50 to 100 feet to an inch. The most prominent producer was the Sanborn Map Company, which mapped more than 12,000 U.S. cities between 1870 and 1950. Maps were updated regularly and provided detailed information about buildings and their surroundings, including construction material (e.g., wood, brick, stone); height; number of stories; locations of doors, windows, chimneys, and elevators; use of the structure; street address; lot lines; street width; and water sources, including water pipes, hydrants, and cisterns. Because the maps represented diverse factors affecting relative risk, a local fire insurance firm could share its liability and premiums with insurers elsewhere and thus avoid being wiped out by a major conflagration.

Chemicals stored on site or dispersed across a wide area were originally considered a hazard only if they were explosive or readily combustible. In the latter half of the century, biologist Rachel Carson described the threat of DDT and similar pesticides in her best seller *Silent Spring* (1962) and awakened citizens to a range of environmental hazards. Public awareness of the deteriorating conditions of land, air, water, and biota peaked in 1970, when the first Earth Day created an impetus for important federal environmental laws. The National Environmental Policy Act (NEPA), an overarching law passed that same year, expressed lofty goals for environmental regulators. The Emergency Planning and Community Right-to-Know Act (EPCRA), passed two years after a 1984 chemical plant accident killed at least 3,000 residents of Bhopal, India, helped communities gather data and map existing chemical hazards. The National Flood Insurance Program (NFIP), established in 1968, eventually produced a comprehensive program of emergency planning maps, nationwide in scope (U.S. FEMA 1992). Originally available only on paper, federal flood insurance maps were converted to a digital format in the early twenty-first century.

The Environmental Protection Agency (EPA), established in 1970, and the Federal Emergency Management Agency (FEMA), created in 1979, advanced the cause of emergency management not only through their mandated regulatory and monitoring activities but also by providing data useful to state and local emergency management agencies. Both agencies implemented regional programs for emergency planning, and EPA regional offices offered training to local jurisdictions. The advent of the EPA inextricably linked emergency management to environmental concerns insofar as the monitoring and gathering of environmental data also served to enhance emergency planning. Mapping intended specifically for emergency planning was often improved by existing geospatial data, readily available in the locality's geographic information system (GIS). In addition, the EPA distributed copies of CAMEO (Computer-Aided Management of Emergency Operations), a software application that local governments could use in conjunction

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