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THE STATUS OF TOPO- GRAPHIC MAPPING IN THE WORLD

A UNGGIM - ISPRS PROJECT 2012 - 2015



Contents

Abstract	1
1 Origins of the Project	1
2 The UNGGIM-ISPRS Project	6
3 The Questionnaire	6
4 Content of the database	7
5 Mapping Contributions by Private Industry	29
5.1 Google	29
5.1.1 Google Earth	30
5.1.2 Google Maps	30
5.1.3 Google Street Map	30
5.1.4 Google Ground Truth	31
5.2 Microsoft Bingmaps	32
5.3 Yandex	33
5.4 HERE	33
5.5 TomTom	34
6 Mapping by Military Organizations	34
7 Summary of Results	35
8 Future Activities	35
9 References	35
Appendix I Original Questionnaire	36
Appendix II Maps from Reports	39
Appendix III Maps from the Internet	49
Appendix IV Maps from Staatsbibliothek Berlin	54

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Abstract

In December 2011 UNGGIM initiated a cooperative project with ISPRS to resume the former UN Secretariat studies on the status of topographic mapping in the world conducted between 1968 and 1986. After the design of a questionnaire with 27 questions, the UNGGIM Secretariat sent the questionnaires to the UN member states. 115 replies were received from the 193 member states and regions thereof. Regarding the global data coverage and age the UN questionnaire survey was supplemented by data from the Eastview database. For each of the 27 questions an interactive viewer was programmed permitting the analysis of the results. The authoritative data coverage at the various scale ranges has greatly increased between 1986 and 2012. Now a 30% 1:25 000 map data coverage and a 75% 1:50 000 map data coverage has been completed. Nevertheless there is still an updating problem as data for some countries are 10 to 30 years old. Private Industry with Google, Microsoft and Navigation system providers have undertaken huge efforts to supplement authoritative mapping. For critical areas on the globe MGCP committed to military mapping at 1:50 000. ISPRS has decided to make such surveys a sustainable issue by establishing a working group.

1 Origins of the Project

In 1986 the Department of Technical Cooperation for Development of the United Nations Secretariat has completed the last survey on the „Status of World Topographic and Cadastral Mapping“. The results of the survey were published by the United Nations, New York 1990 in World Cartography, Vol. XIX. The text was submitted by the UN Secretariat as document E/CONF 78/BP7 in 1986 prepared by A.J. Brandenberger and S.K. Ghosh of the Faculty of Forestry and Geodesy at Laval University, Quebec, Canada. It referred to previous surveys submitted by the Department of Technical Cooperation for Development of the United Nations Secretariat in 1968 published in World Cartography XIV and in 1974 and 1980 published in World Cartography XVII.

The paper published in World Cartography XIX in 1990 summarized the progress made in topographic mapping across the globe between 1968 and 1980 in 4 scale categories:

range I; scales between 1:1000 and 1:31 680
range II; scales between 1:40 000 and 1:75 000
range III; scales between 1:100 000 and 1:126 720
range IV; scales between 1:140 000 and 1:253 440

These ranges represent the more recently standardized scales:

range I; scale 1:25 000
range II; scale 1:50 000
range III; scale 1:100 000
range IV; scale 1:250 000

While scale in the age of digital cartography has changed the meaning, the scale ranges nevertheless maintain their significance with respect to the resolution of mappable details.

The 1986 survey covered the following number of countries or territories:

Africa	53 countries	4 territories
North America	24 countries	13 territories
South America	12 countries	3 territories
Europe	39 countries	4 territories
Asia	40 countries	3 territories
USSR	1 country	0 territories
Oceania	11 countries	17 territories

Antarctica was not included in the survey.

Source of the data obtained by the surveys were completed questionnaires, sent by the UN Secretariat to the UN member countries, plus additional surveys made directly by Laval University for UN member countries not having answered the questionnaires, for non-UN member countries and for territories under foreign administration. The result of the survey was for each region and for the different scale ranges:

	range I	range II	range III	range IV
Africa	2.3%	29.7%	20.6%	86.8%
North America	41.3%	68.2%	8.0%	92.8%
South America	9.7%	29.0%	44.2%	50.4%
Europe	92.5%	93.8%	81.3%	95.7%
Asia	16.0%	62.7%	65.4%	92.0%
USSR	>5%	>60%	100%	100%
Oceania	13.3%	15.6%	36.1%	99.8%

The areas covered by the survey were:

	range I	range II	range III	range IV
Africa	75.8%	100%	100%	100%
North America	90.7%	100%	100%	99.5%
South America	100%	100%	100%	100%
Europe	98.0%	90.2%	97.25%	96.7%
Asia	87.8%	90.9%	87.6%	90.2%
USSR	100%	100%	100%	100%
Oceania	94.1%	94.5%	94.3%	99.9%

World summary:

	range I	range II	range III	range IV
area of survey 1986	90.1%	97.4%	97.0%	97.75%
1986 map coverage	17.9%	49.3%	46.4%	87.5%
1980 map coverage	13.3%	42.2%	42.2%	80.0%
1974 map coverage	11.6%	35.0%	40.5%	80.5%
1968 map coverage	7.7%	23.4%	38.2%	81.0%

Since the last survey in 1986 considerable progress has been made in data coverage:

	range I	range II	range III	range IV
2012 map coverage	33,5%	81.4%	67.5%	98.4%

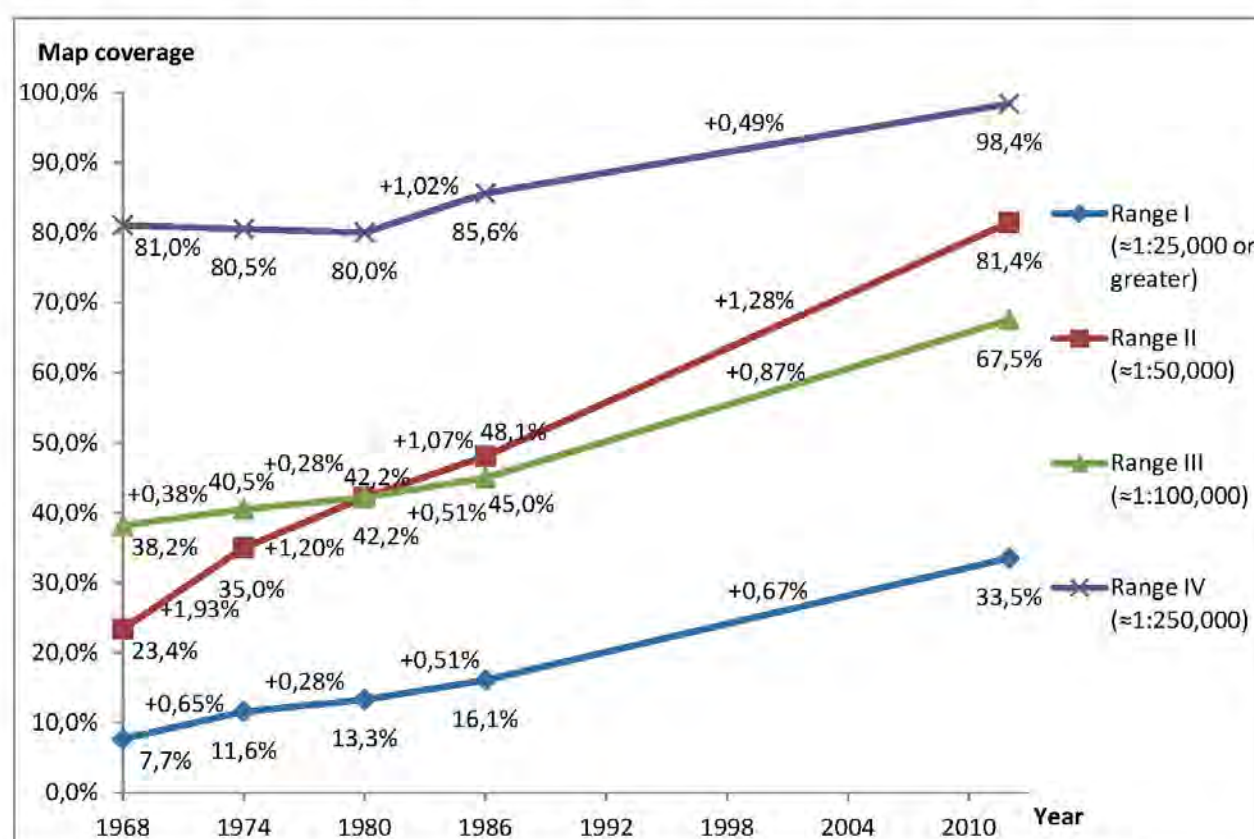


Chart I: Percentages of total world area covered in each scale category, 1968-1974-1980-1986-2012

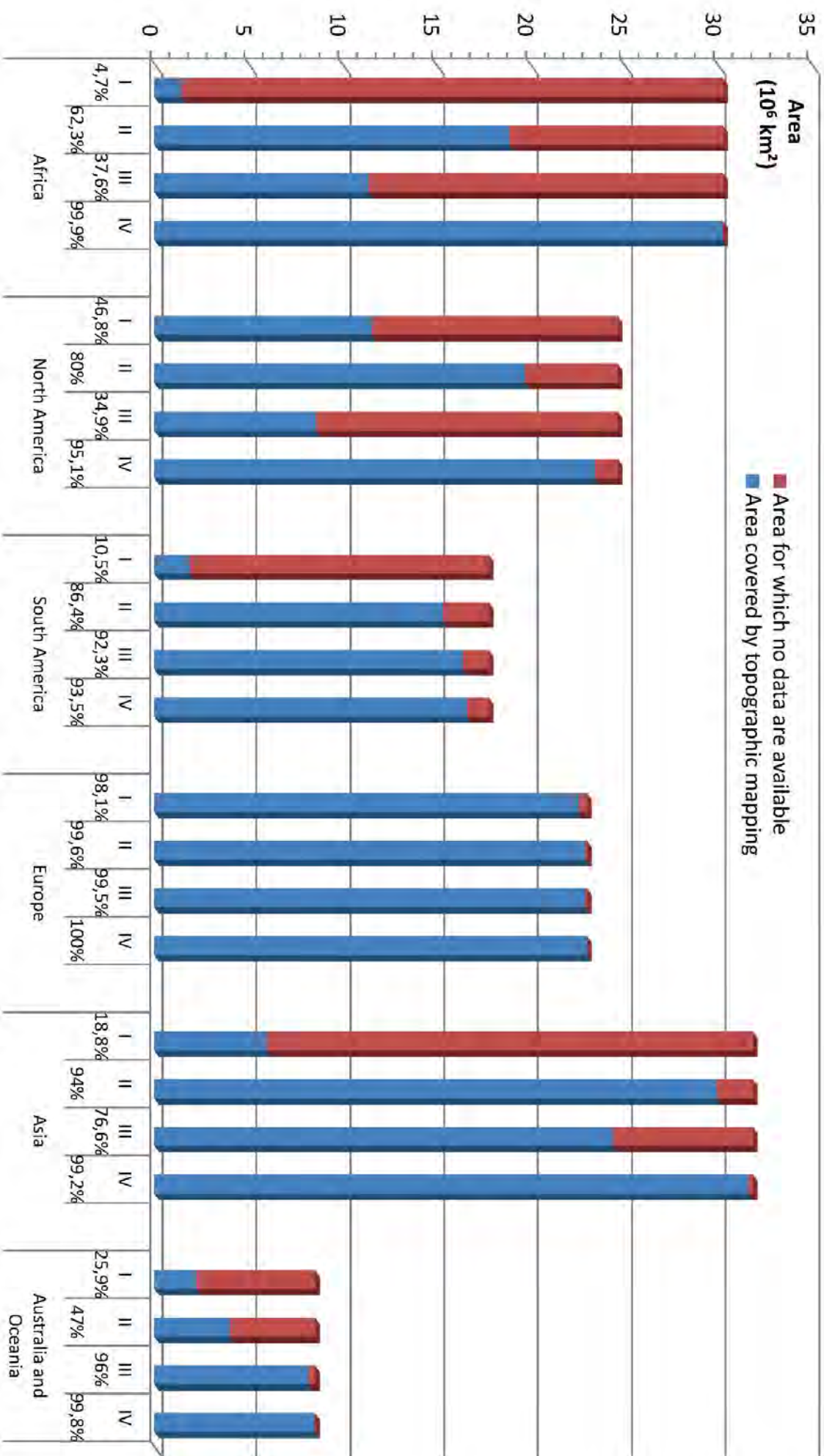


Chart 2: Area covered by topographic mapping on four scale ranges, by geographical region, 2012

While the surveys presented in 1986 did not concentrate on map revision on a global basis, they nevertheless derived an update rate for the four scale ranges:

	range I	range II	range III	range IV
update rate 1986	3.2%	1.8%	2.7%	3.6%

This points to the fact, that in 1986 the maps at the scale relevant to national planning operations 1:50 000 were hopelessly out of date.

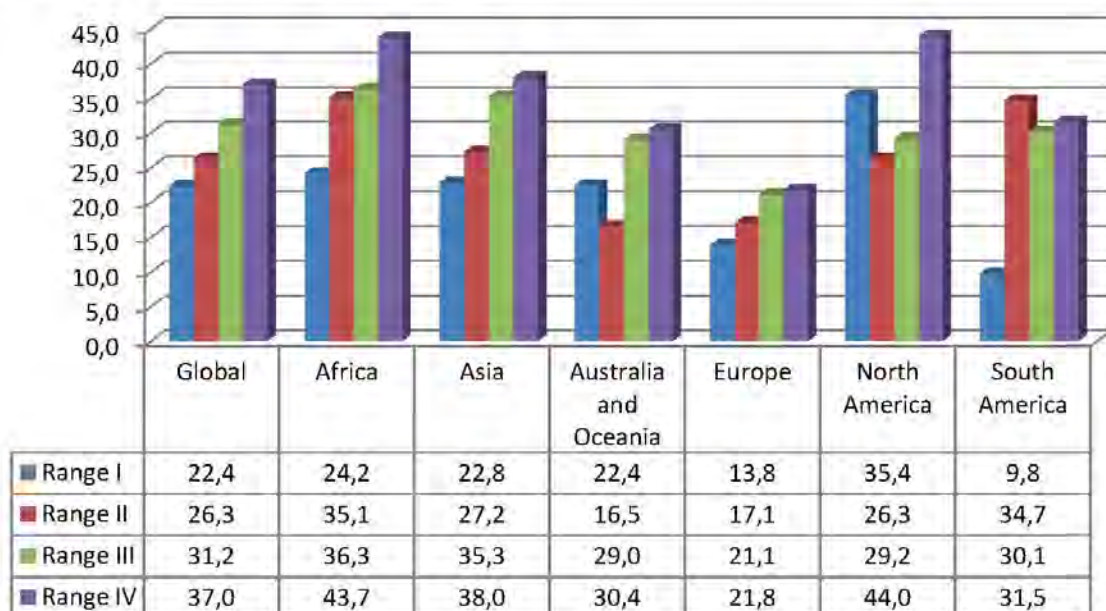


Chart 3: Average map age in years counting from 2012

Other aspects of the surveys conducted in 1980 were directed toward the existence of geodetic networks and their density. In 1980 there existed 3.67 M horizontal and 3.16 M vertical control monuments on the globe, but again their density varied from 2.66 km² per horizontal control monument and 3.61 km² per vertical control monument in Europe to 232 km² in Africa with an average of 42.5 km² per horizontal control monument to 46.4 km² per vertical control monument.

Today the GNSS technology makes control point densities irrelevant, except for the case, when old map data need to be referenced to a global datum.

In 1980 the national mapping agencies possessed 12 120 theodolites, 5790 precise leveling instruments and 1914 EDM devices, 162 airplanes for aerial photography, 267 aerial survey cameras and 3120 photogrammetric stereo plotting instruments. Disregarded in that survey are instruments owned by companies mapping for governments under contract.

Again, the availability of geodetic instrumentation is not of essence to judge progress any more. The attempts of 1980 to determine the existing manpower of the national mapping agencies for each region were based on few countries only (e.g. Algeria and Nigeria for Africa, the USGS in the USA, the Surveys and Mapping Branch in Canada, the IGN France in Europe). These data were used to extrapolate the requirements in other countries with the attempt to develop a budget of global expenditures, yielding a global sum of US\$ 868 million, at that time 0.010% of the gross national product, while the global surveying and mapping activities at that time were estimated to be between 8 to 9 billion US\$ per year. A program for

increasing the expenditures to 0.02% of the GNP was recommended in the report to meet the need for lacking mapping coverage and lacking map updates.

The financing of geospatial information is a very complex issue. To track progress these tasks should now be transferred to another UNGGIM Working Group

The rather inaccurate and inconclusive results of 1986 may have discouraged the UN Secretariat in continuing the past surveys due to lack of a budget for this purpose.

2 The UNGGIM-ISPRS Project

The United Nations Regional Cartographic Conferences (UNRCC) for the Americas and for Asia and the Pacific nevertheless continued to recommend to the Secretariat to continue the studies on the global status of mapping. One of these resolutions of the UNRCC for the Americas in 2009 gave the mandate to the Secretariat for a new survey.

This happened at the time, when UNGGIM (United Nations Global Geospatial Information Management) was created as a new structure.

ISPRS approached the director of UNGGIM in 2011 to start a joint project on the survey of the status of topographic geospatial information,

- because the issue is of global interest
- because new technologies, such as GNSS (GPS, GLONASS), digital aerial mapping, high resolution satellites for mapping, digital photogrammetry and GIS have taken over as new mapping methodologies
- because large private organizations such as the navigation industry (Here, Tomtom), Google Earth and Microsoft Bingmaps have entered the mapping effort, which was previously the domain of the national mapping agencies.

The project was approved in December 2011 by Dr. Paul Cheung, director of UNGGIM at that time, who nominated Dr. Amor Laaribi as UNGGIM contact, and by Chen Jun, President of ISPRS, who nominated Prof. Gottfried Konecny of Leibniz University Hannover as ISPRS contact.

In January 2012 a questionnaire to the UN member states was designed, mutually discussed, translated to French, Russian and Spanish and mailed to the contacts of the UNGGIM Secretariat in the UN member states. Ms. Vilma Frani of the UNGGIM Secretariat sent the replies to Leibniz University Hannover, where they were placed in a database designed by Uwe Breitkopf for further analysis.

3 The Questionnaire

The jointly designed questionnaire consists of five parts including 27 Questions:

- PART A: Background Information
- PART B: National Topographic Mapping Coverage
- PART C: National Imagery Acquisition
- PART D: National Surveying and Cadastral Coverage
- PART E: Organization

See Appendix I for the original questionnaire.

Until June 2015 altogether 115 responses have been received from 193 UN member states or regions thereof. In addition, there are 51 non-UN member countries and territories, which are also covered by map data. These map data for 244 UN member states and regions were generated in UN member states, but these have in general no direct responsibility for mapping these territories.

Fig. 1 shows the 115 states or regions from where replies have been received, which have answered the UNGGIM-ISPRS questionnaire.

Answers were almost complete from Europe (with the exception of Belarus), they were satisfactory from the Americas (with the exception of Argentina) and in Oceania. In Asia India, Pakistan, Myanmar, Kazakhstan, some Central Asian countries and Indonesia did not participate in the survey. In Africa about half the countries did not share their information. Nevertheless the response by 115 member states and regions thereof from 193 UN Member States is considered a success by the UN.

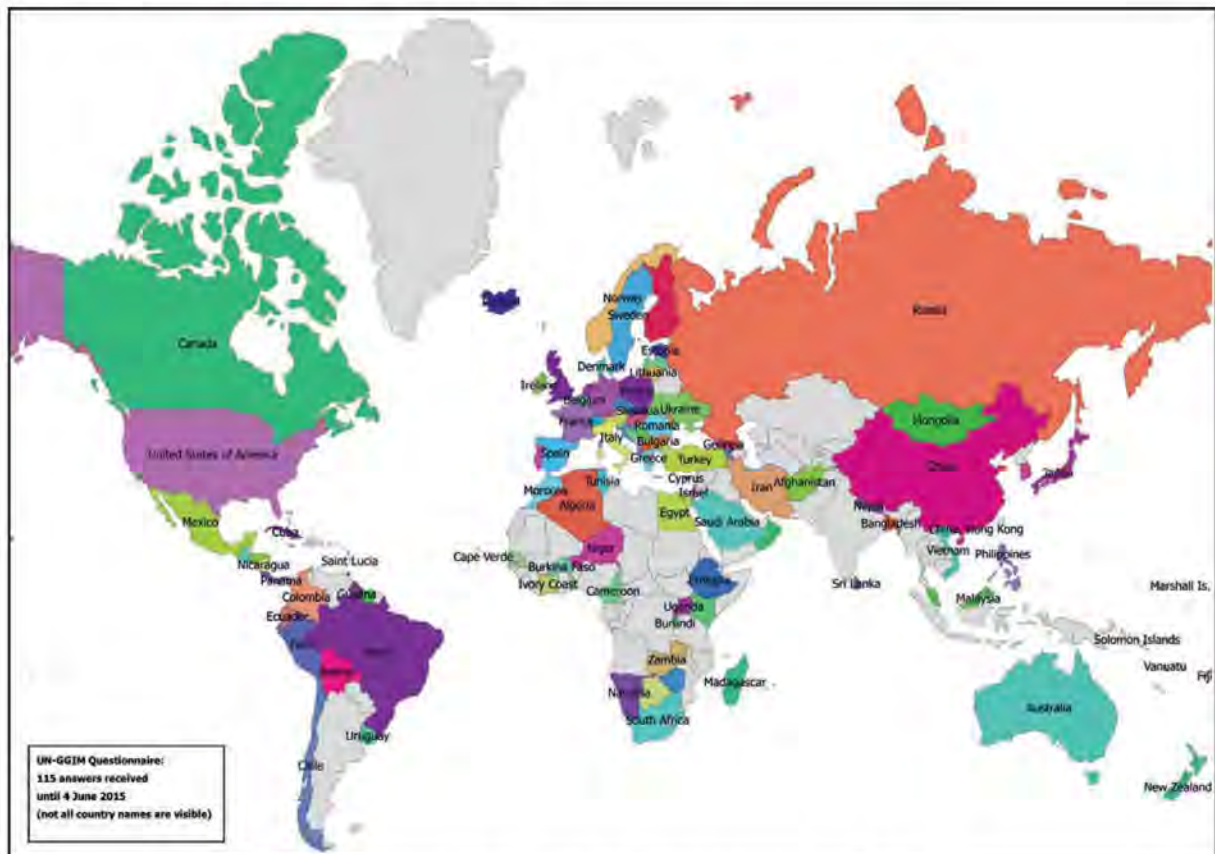


Fig. 1: 115 countries have replied the Questionnaire until June 2015

4 Content of the database

While not all of the 27 questions need to be answered globally, this is, however, important for questions 1 and 2, since they characterize the global data coverage at the different scale ranges and their age of the data.

To assess the global status of map coverage the Eastview database is a fundamental component to answer these questions. Dr. Kent Lee, CEO of Eastview has kindly agreed to make the missing data available from their database.

The map sources at Eastview include locally produced (e.g. by national mapping agencies) as well as military map series, see Appendix II-13 and 14 as an example.

Besides Eastview other sources were analyzed to fill the gaps in the study and estimate global coverage. These include UN reports accompanying the questionnaires, internet portals for national mapping data, the cartographic database of the German State library of Berlin based in part on the Geokatalog of the map vendor ILH Stuttgart and others see Appendix II to IV for examples.

Regarding question 1 Fig. 2 to Fig. 5 show the global coverage in the scale ranges 1: 25 000 or greater, 1: 50 000, 1: 100 000 and 1: 250 000.

Europe, the Russian Federation, Turkey, Japan and the continental USA are well represented in the 1:25 000 scale range, as well as the Western part of China. In the remainder of the world that scale range only covers a small part of the countries.

The scale range 1:50 000 and larger, on the other hand covers the continents of Europe, North America, Asia and the Arab world, most of South America and New Zealand. Australia and Algeria are covered to about 40% to 60% and Mongolia to about 30%. Only in the desert areas of the Africa and South America the coverage is less than 15%.

Australia and Papua-Niugini are fully covered by 1:100 000 maps, as well as Latin America. With few exceptions the land areas of the globe are covered at the 1:250 000 scale range with the exception of Greenland with 45% and Antarctica with 4%.

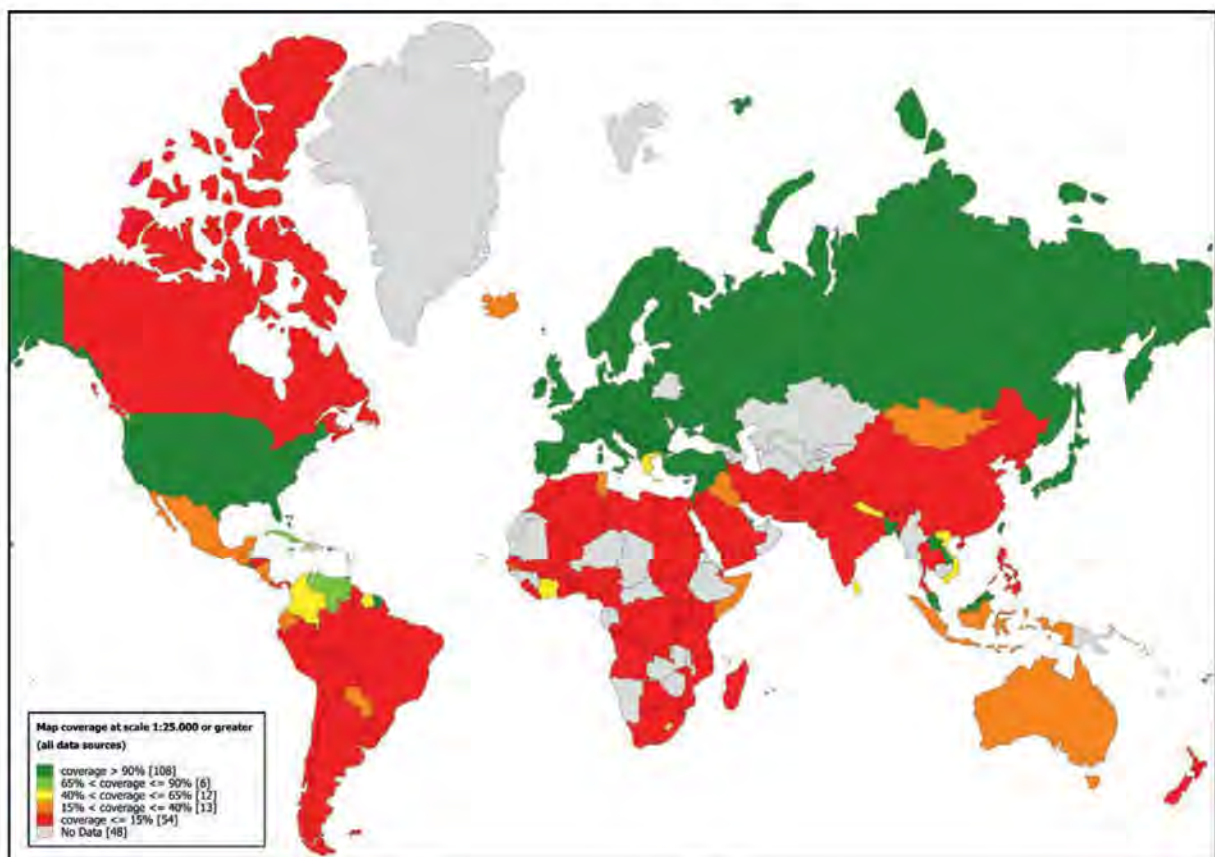


Fig. 2: Map coverage at scale 1:25 000 or greater

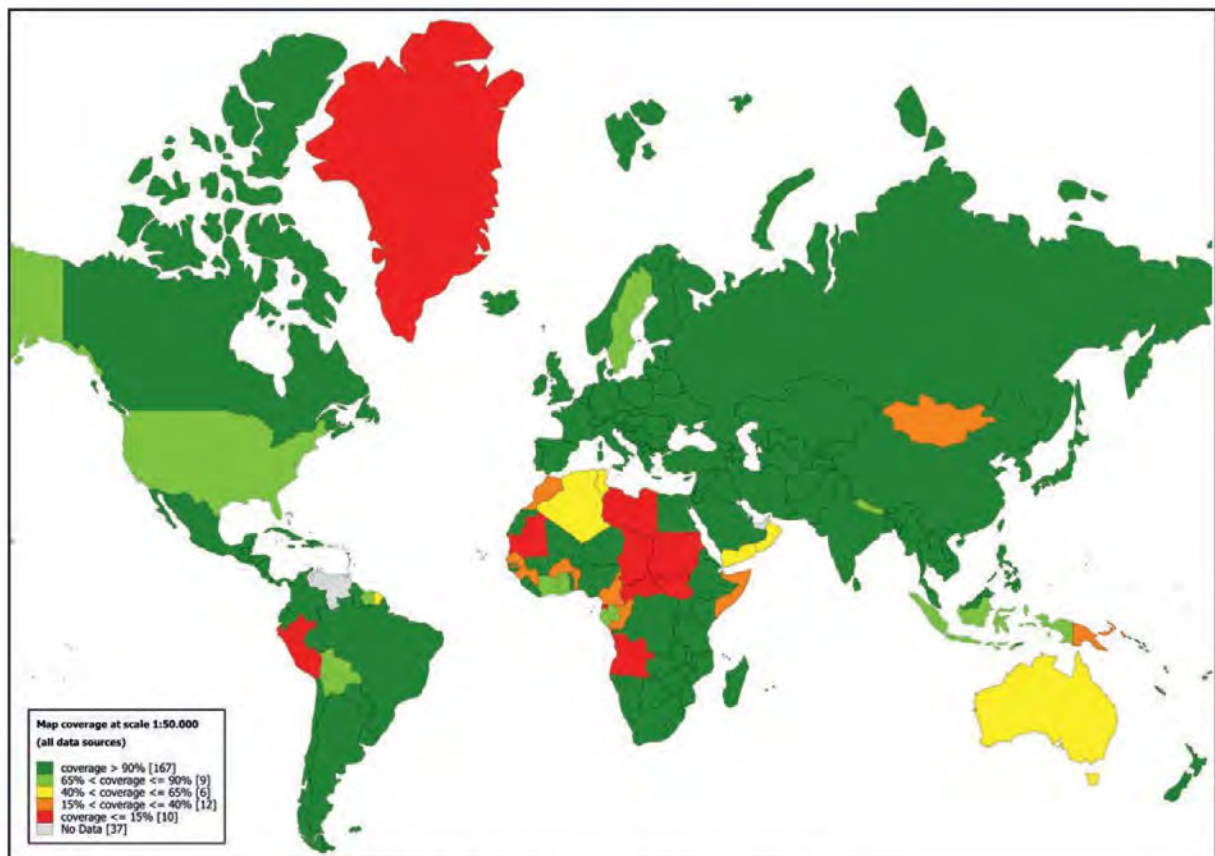


Fig. 3: Map coverage at scale 1:50 000

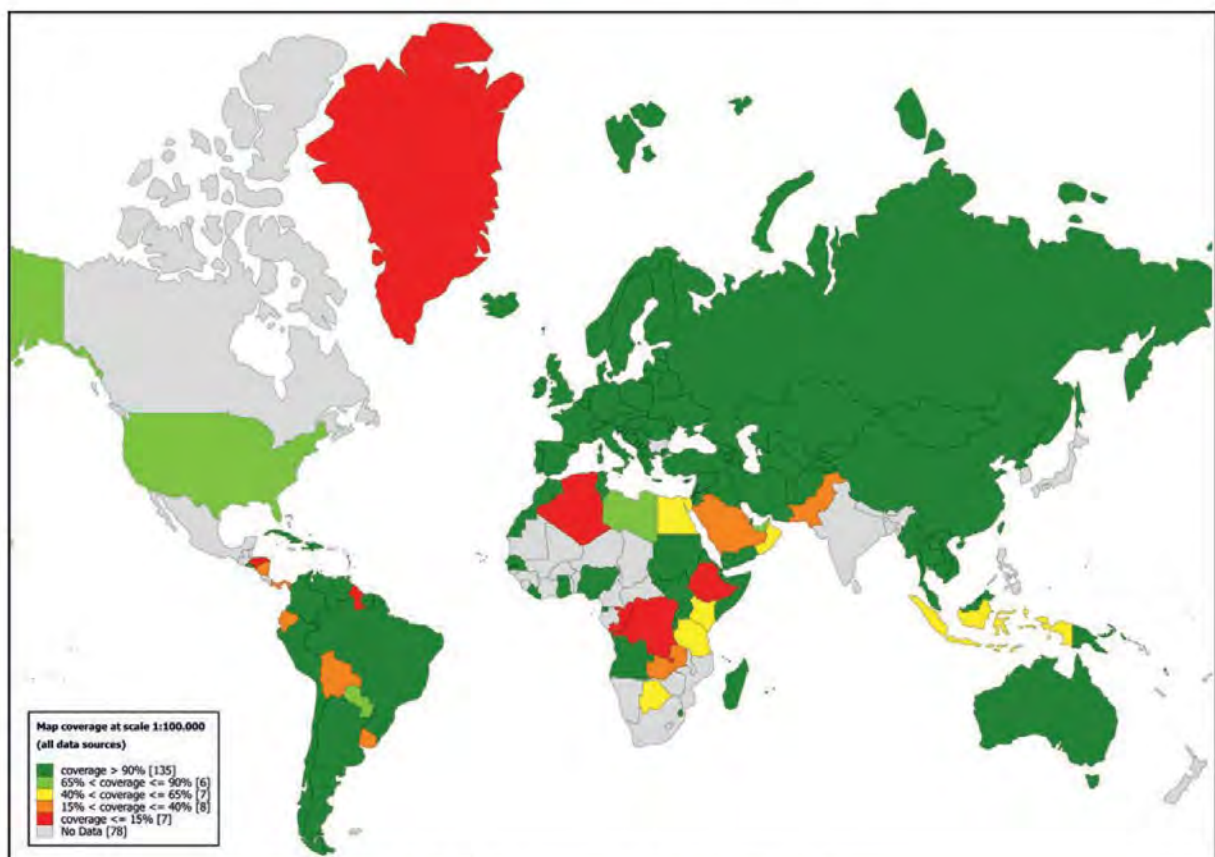


Fig. 4: Map coverage at scale 1:100 000

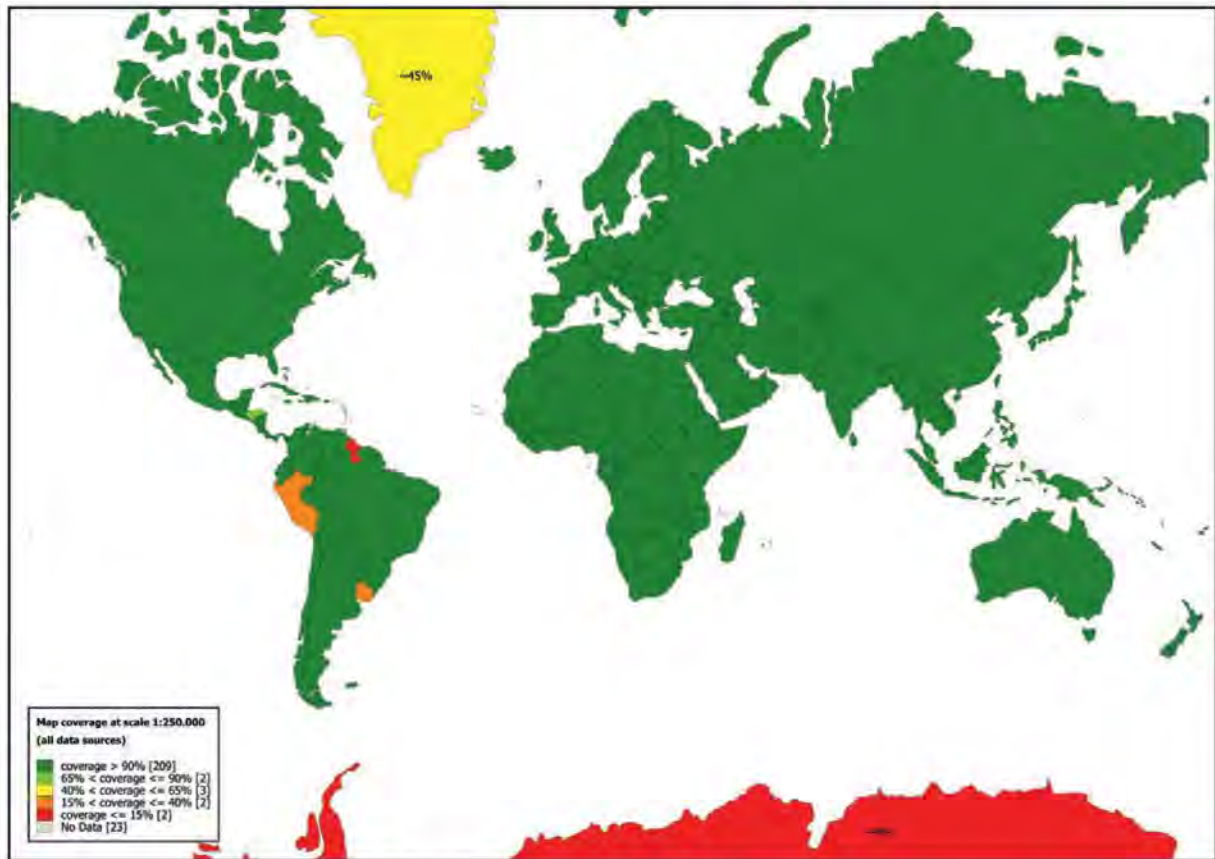


Fig. 5: Map coverage at scale 1:250 000

With only 59% of the UN member states having answered the questionnaire, other sources had to be utilized to assess the global coverage. Chart 4 and Fig. 6 to Fig. 9 give the source of the meta data information for Fig. 2 to Fig. 5.

Concentrating on the globally important scale range 1:50 000 only 22% of the relevant information stems from the questionnaires received. 5.4% are added from country reports to UNGGIM, 2.9% from Internet portals. 12% of the metadata came from Eastview, 19.1% from the State Library Berlin plus 5.8% from other sources and 17.4% on what has previously been compiled by Laval University in the 1986 study, totaling 91% of the information.

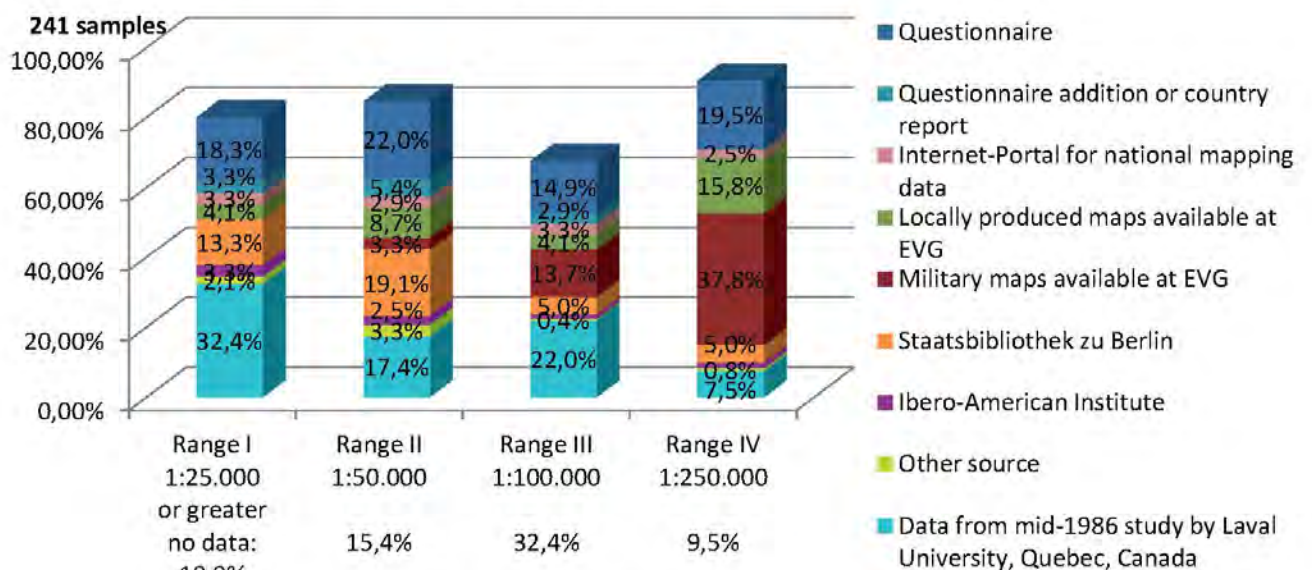


Chart 4: Data source for coverage per scale category

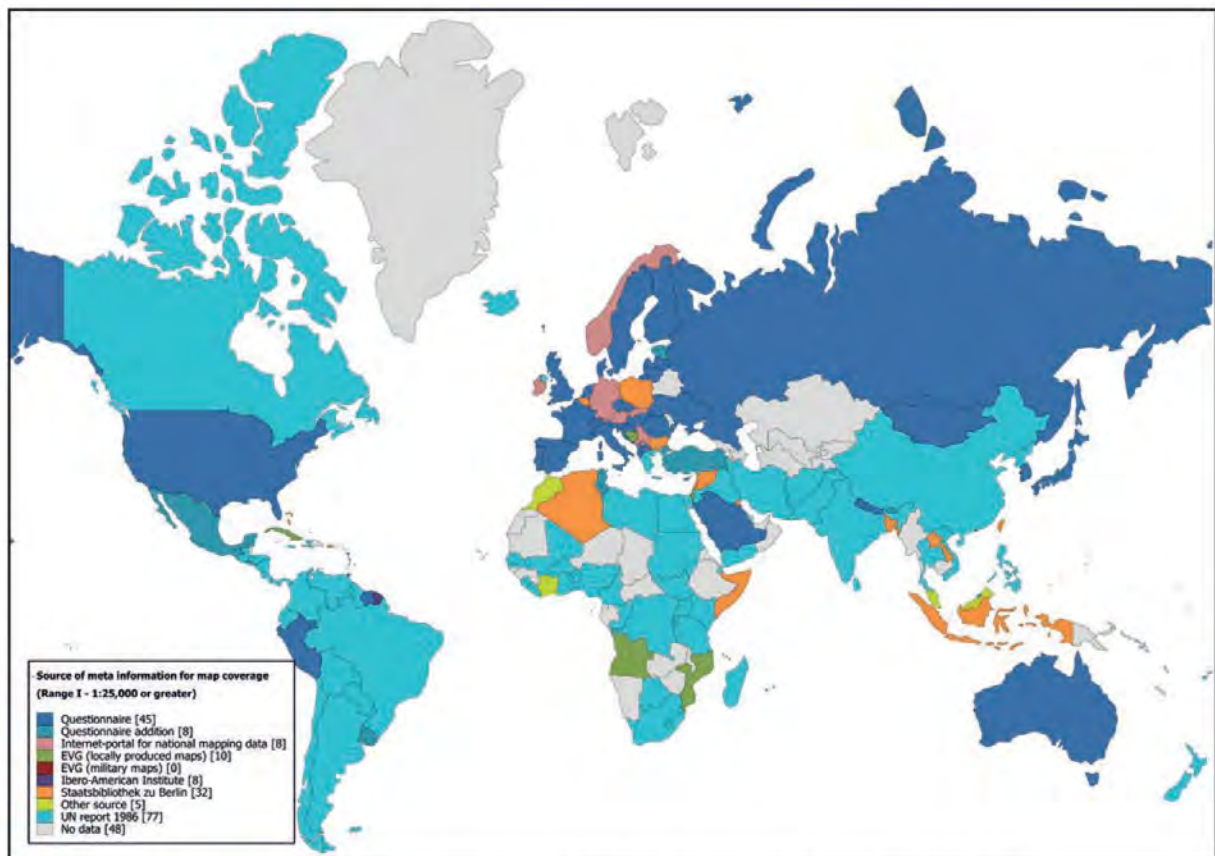


Fig. 6: Source of meta information for map coverage in range I - 1:25,000

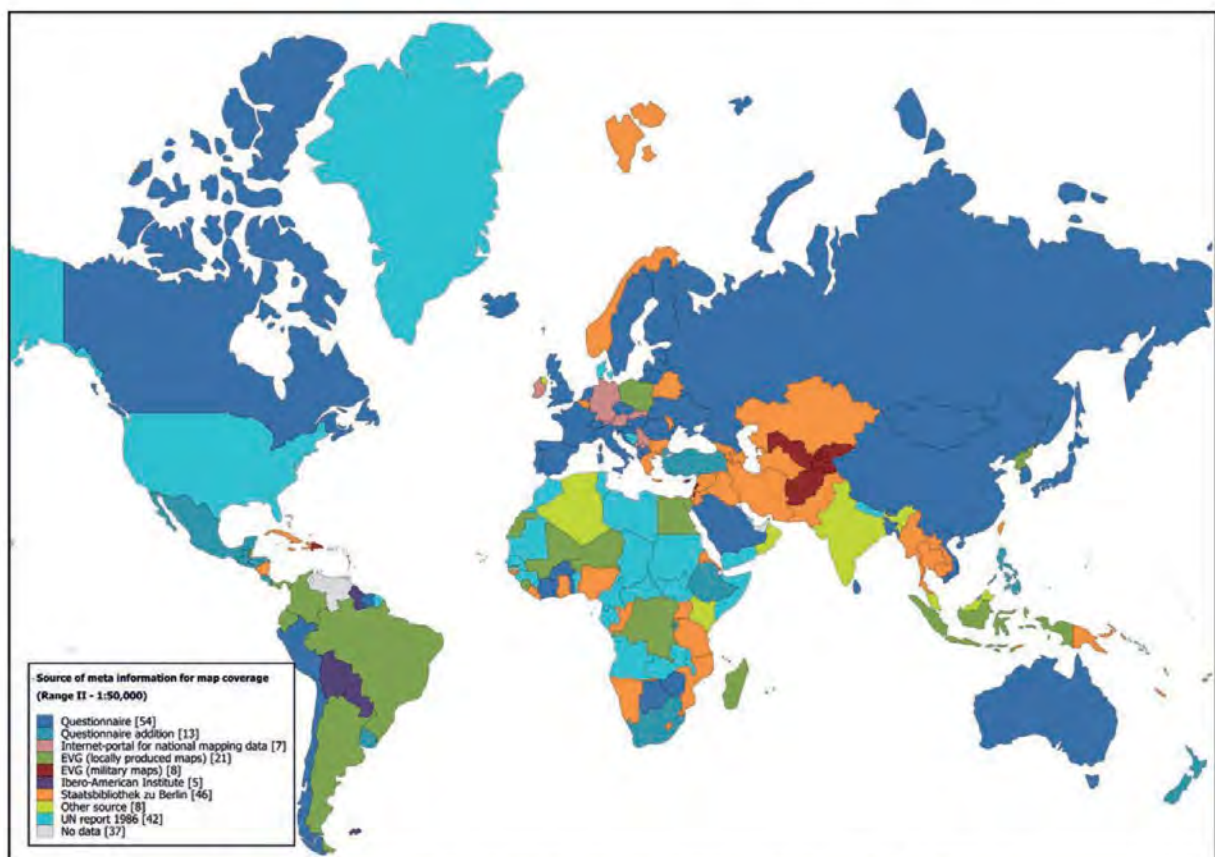


Fig. 7: Source of meta information for map coverage in range II - 1:50,000

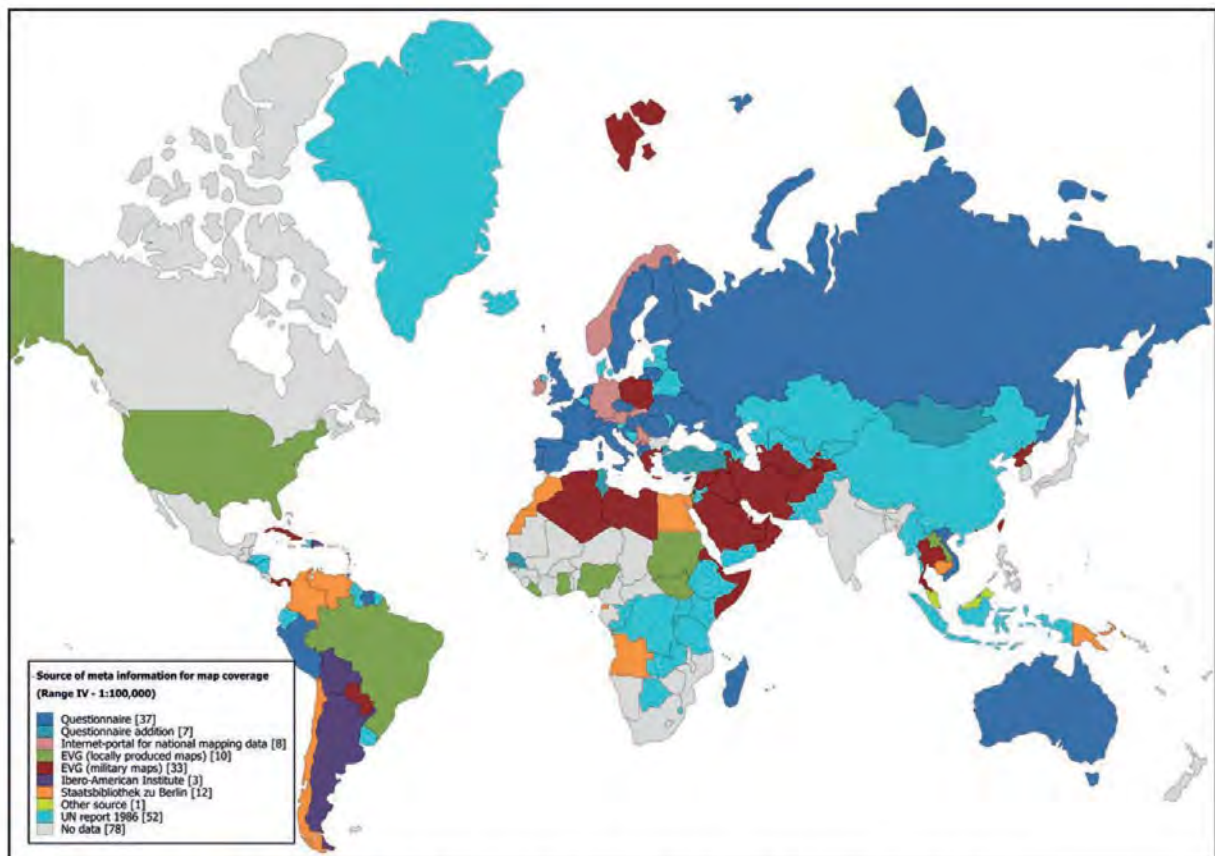


Fig. 8: Source of meta information for map coverage in range III - 1:100,000

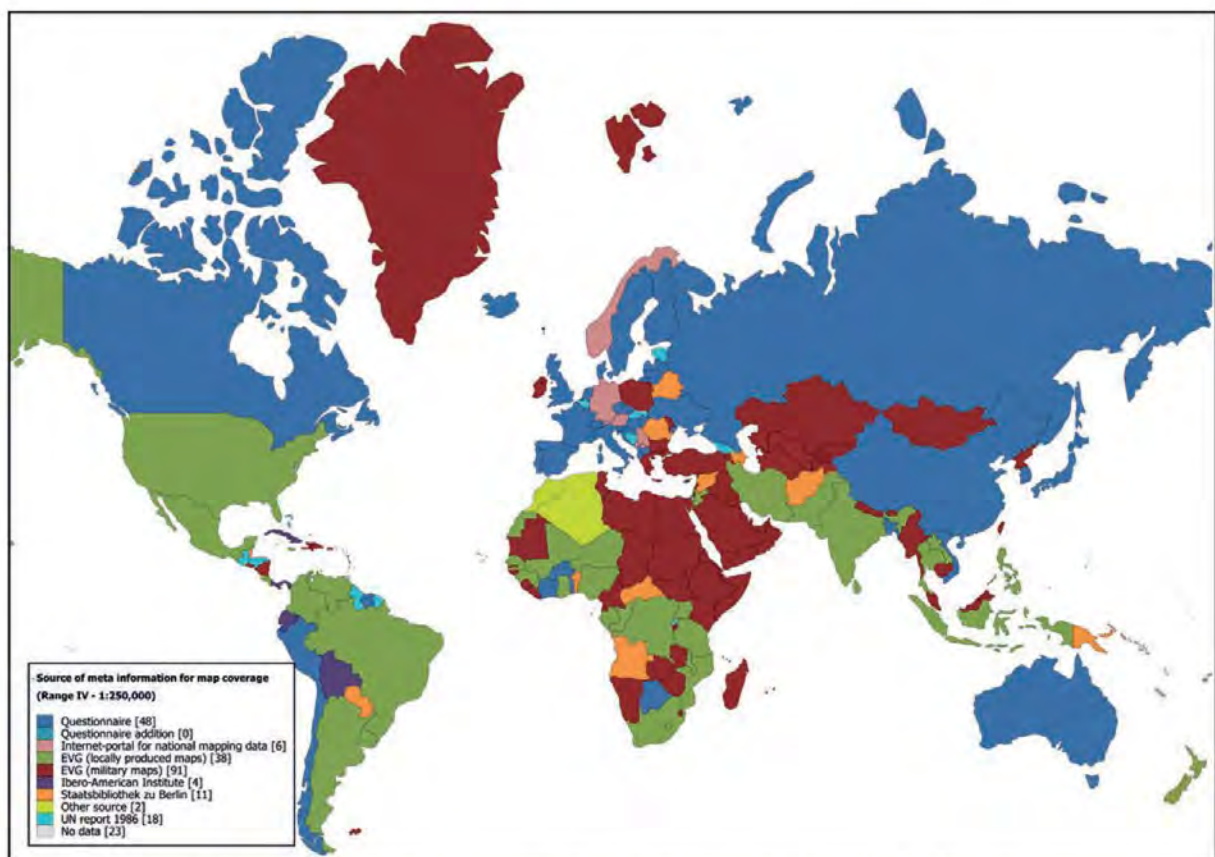


Fig. 9: Source of meta information for map coverage in range IV - 1:250,000

Fig. 10 to Fig. 13 shows the equivalent data to Fig. 2 to Fig. 5 for the year 1986, depicting the huge progress made through technology from 1986 to 2012. Also Fig. 14 highlights the change in map coverage between 1986 and 2012.

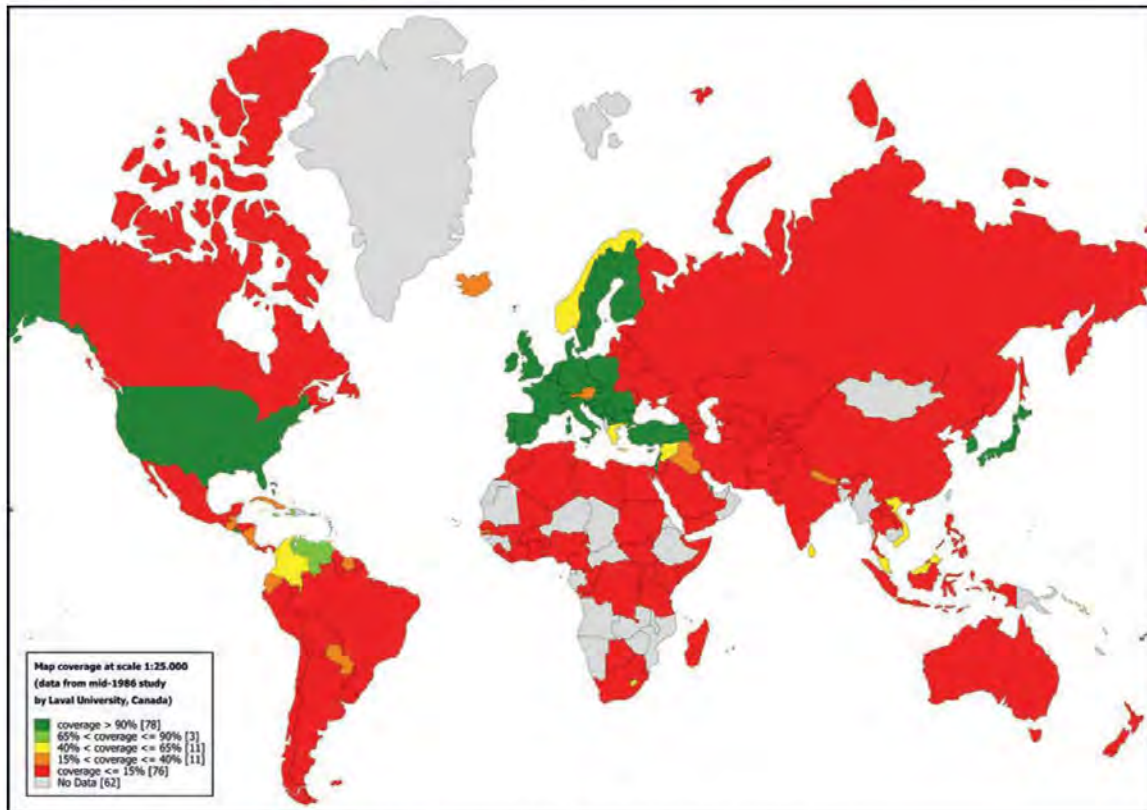


Fig. 10: Map coverage 1986 at scale 1:25 000 or greater

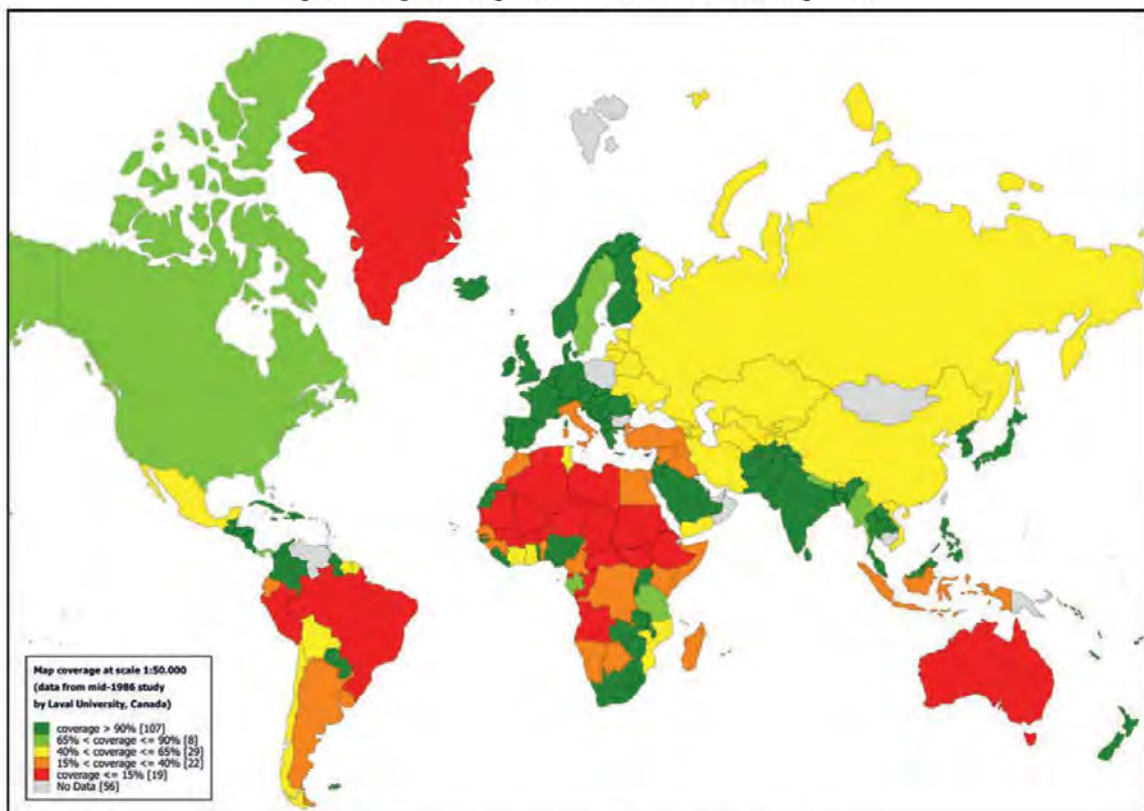


Fig. 11: Map coverage 1986 at scale 1:50 000

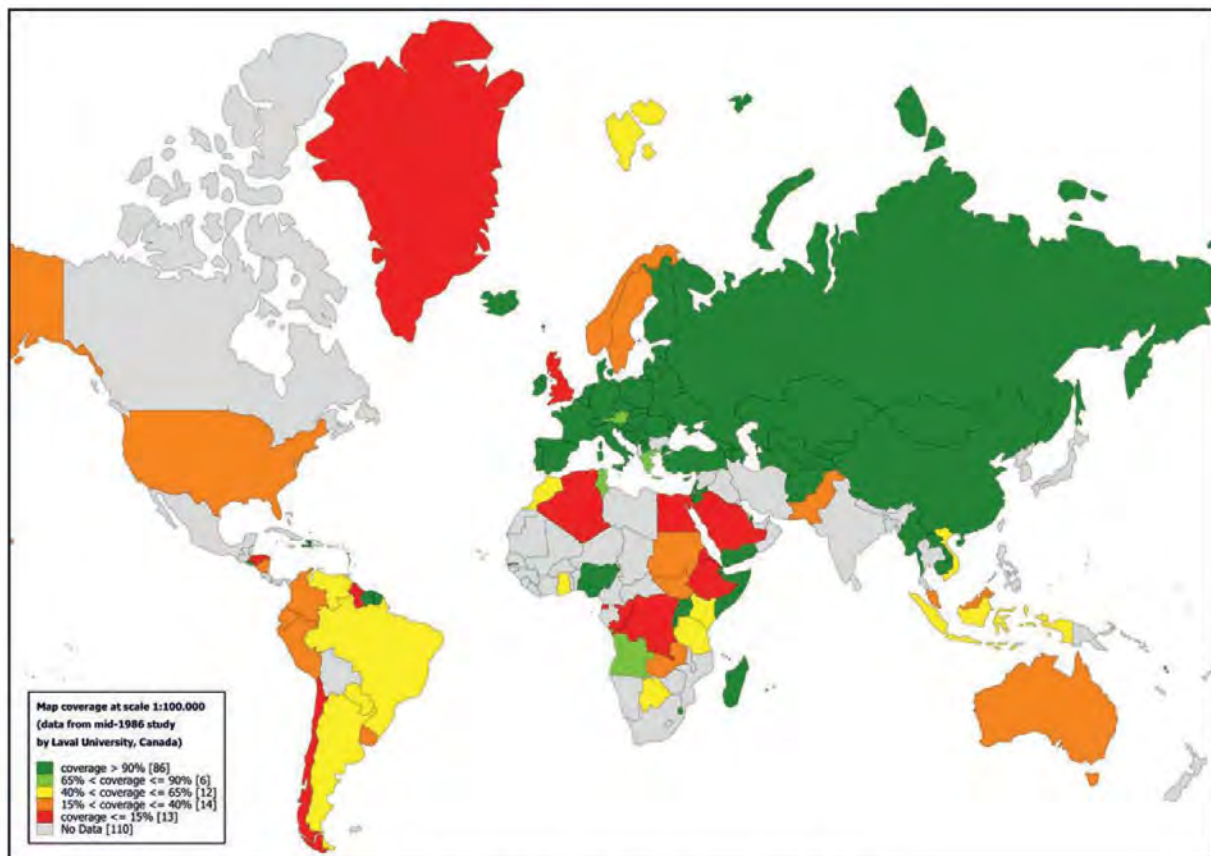


Fig. 12: Map coverage 1986 at scale 1:100 000

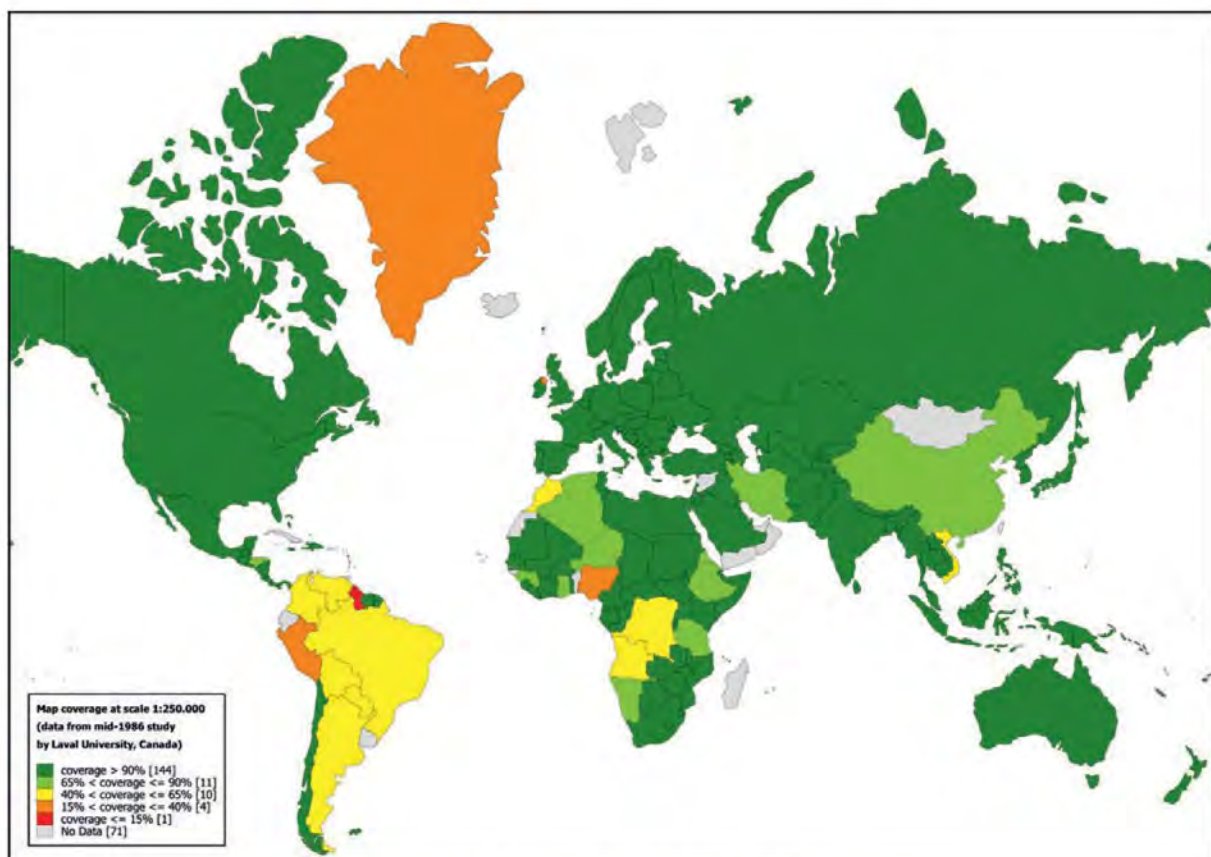


Fig. 13: Map coverage 1986 at scale 1:250 000