

THE INTERNATIONAL SOCIETY FOR PHOTOGRAMMETRY AND REMOTE SENSING (ISPRS) STUDY ON THE STATUS OF MAPPING IN THE WORLD

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Abstract:

Within the UN Secretariat and the ISPRS Community there has been a long-time interest to document the current status of basic mapping and its updating in the world. The early attempts for the UN Cartographic Conferences in the 1960's, 1970's and 1980's have not been followed up due to lack of resources. After the creation of UNGGIM by UN ECOSOC in 2009 a new attempt to continue this has been launched under the initiative of ISPRS. A joint questionnaire was designed between ISPRS and UNGGIM, and the GGIM Secretariat has mailed it to the UN member States. 91 answers have been received. These are analysed in the paper, subject to verification. An ISPRS Working Group has been created to assure sustainability of the effort.

I. Introduction

1. In 1968, 1974, 1980 and 1987 the UN Secretariat has completed studies on the status of world topographic mapping. Topographic maps at that time constituted the basis for reliable geospatial information, as they do up until today.

Topographic maps were and are principally compiled by activities of the governmental national mapping agencies (NMA's). Representatives of these agencies of the UN member countries have regularly exchanged views on the status of mapping at the UN Regional Cartographic Conferences for Asia and the Pacific and for the Americas.

The issues of mapping have gained importance for the national and global management of resources and for sustainable development with increasing emphasis on environmental issues.

The last summary on the status of mapping has been published by the United Nations in their publication "World Cartography" in volume XX, published in 1990 (ST/TCD/14). It reflected the status of topographic mapping surveys up until the year 1986. As of 1980 the scope of mapping also began to include cadastral mapping, as a basis for land management issues.

The results of the published study for topographic mapping coverage of the land area of the world resulted in the following summary:

scale/range	1:25 000	1:50 000	1:100 000	1:200 000
Africa	2,9 %	41,4 %	21,7 %	89,1 %
Asia	15,2 %	84 %	56,4 %	100 %
Australia and Oceania	18,3 %	24,3 %	54,4 %	100 %
Europe	86,9 %	96,2 %	87,5 %	90,9 %
Former USSR	100 %	100 %	100 %	100 %
North America	54,1 %	77,7 %	37,3 %	99,2 %
South America	7 %	33 %	57,9 %	84,4 %
World	33,5 %	65,6 %	55,7 %	95,1 %

The survey also revealed that not only the coverage of maps was an important factor, but also the update rates of the topographic map. These were in summary:

scale/range	1:25 000	1:50 000	1:100 000	1:200 000
Africa	1,7 %	2,2 %	3,6 %	1,4 %
Asia	4,0 %	2,7 %	0 %	1,9 %
Australia and Oceania	0 %	0,8 %	0 %	0,3 %
Europe	6,6 %	5,7 %	7,0 %	7,5 %
Former USSR	0 %	0 %	0 %	0 %
North America	4,0 %	2,7 %	0 %	6,5 %
South America	0 %	0,1 %	0 %	0,3 %
World	5,0 %	2,3 %	0,7 %	3,7 %

Since the last publication of the data on the status of mapping there have been highly effective technology improvements in IT in sensor technology and in the availability of satellite platforms.

Foreseeing these UN Cartographic Conferences have passed a number of resolutions to update the effort on the status of mapping within existing resources.

2. The Ninth UNRCC for the Americas in New York 2009 in its resolution 3/IX has tasked the UN to prepare a study on the status of mapping in the world by study to be directed to the national geospatial information authorities in the world.

In this context the International Society for Photogrammetry and Remote Sensing ISPRS has offered technical support to the GGIM Secretariat.

3. In preparation for this survey by the UNGGIM Secretariat a questionnaire was jointly designed, which was sent out to the geospatial information authorities on April 27, 2012.

II. Design of the Questionnaire

4. The questionnaire was designed to give answers, not only on the progress in area coverage of mapping during the last 26 years, and the status of up-to-dateness of the maps, but also on the status of introducing new technology and expanded tests in the different countries, characterizing the existing national infrastructure for mapping.

Altogether 27 questions were formulated as multiple choice questions:

A) National Topographic Mapping Coverage: 7 questions

- 1) the scales of mapping in use in 8 categories (1:1000, 1:5000, 1:25 000, 1:50 000, 1:100 000, 1:250 000, 1:500 000, 1:1 000 000 or similar) and coverage of the data in km² or in % of the national area
- 2) the age of map data
- 3) restrictions imposed on the availability of maps
- 4) maps for sale or for free
- 5) procedure of map updates by map sheet or by features
- 6) methodology for updating (field surveys, photogrammetry, satellite imagery, third party data, crowd sourcing)
- 7) inhouse or outsourcing operations

B) National Imagery Acquisition (7 questions):

- 8) is there a national aerial photography program flown at regular intervals; are domestic services used; is the imagery analog or digital
- 9) is there a national satellite imagery acquisition program providing images at regular intervals; are these domestic sources
- 10) use of radar or lidar sensors
- 11) is Lidar used for DEM's and at which resolution
- 12) are orthophotos produced and at which scale
- 13) is there a national DEM

14) is there the intention or use of 3D information for urban and rural landscape models

C) National surveying and Cadastral Coverage (8 questions)

15) are there licensed surveyors

16) is there a national cadastral map coverage and is the NMA responsible for cadastral mapping

17) what is the use of cadastral maps (titles, tax)

18) are cadastral maps based on geodetic control

19) are property boundaries monumented in the field

20) updating methodology of property maps

21) number of employees or private surveyors engaged in cadastral operations

D) Organisation (6 questions)

22) is topographic mapping nationally funded

23) annual budget

24) number of staff (total and technical) in NMA

25) legal or regulatory mandate of NMA

26) products in % supplied as

- hard copy maps
- digital data
- online downloads
- web services

27) archival practices

5. The questionnaire is intended to provide an overview of the current status of mapping the world with characteristic questions relating to the use of new technology for mapping and the cadastre including institutional arrangements on a national level.

III. Status of the Responses

6. After the mailing of the questionnaire on April 27, 2012 altogether 91 responses have been received to date. This is a favourable response. A follow-up process is continuing from the GGIM Secretariat with the help of regional committees.

ISPRS has also addressed their national member organisations to solicit further official responses by personal contacts.

7. ISPRS has initiated the analysis of the responses. A MS-Access database has been developed by Mr. Uwe Breitkopf of the Institute for Photogrammetry and Geoinformation of Leibniz University, Hannover to systematically analyse the replies to the 27 questions in a simplified manner. The database is now usable for the analysis of the responses and is easily expandable and is available to GGIM.
8. The database principally needs to include information on all 193 UN member countries and on all non-UN member regions, bringing the total of areas to be included to over 200.
9. Some information on these over 200 regions can be obtained from international map vendors. The Institute of Photogrammetry and Geoinformation of Leibniz University Hannover has used the web published database of Eastview Geospatial to arrive at an estimate of the map coverages and the update status of the entire globe.
10. The results obtained so far need verification by additional correspondence.
11. To make the effort sustainable, ISPRS has established an international Working Group (WG IV-2 “Status of Geospatial Data Bases”) within its Commission IV (Geospatial Data Bases) for the 2012 – 2016 Congress Period.
12. The first meeting of the Working Group will take place during Interexpo GEO-Siberia in Novosibirsk, Russian Federation, from April 24 to 26, 2013, organized by the Siberian State Academy of Geodesy.
13. With respect to the UNGGIM effort the results of the 2012 survey a publication is intended by July 2013.
14. The verified results are also to be presented to the GGIM Meeting of Experts on Global Geospatial Information Management in Cambridge, July 24 – 26, 2013.

IV. Replies

15. 91 replies were received from 90 U.N. member countries plus 1 from Northern Ireland.

16. European replies (36) were nearly complete, except for Russia, Belarus and Montenegro (3). Small countries, such as San Marino, Liechtenstein or Monaco, which do not have own mapping administrations, were not included in the survey.
17. From the Americas the survey also returned good results (15), except for Argentina, Paraguay, Bolivia, Venezuela, Guyana, Suriname, Cuba, the Dominican Republic, the Caribbean Islands and the Bahamas.
18. Africa is partly covered (20). Missing are Angola, both Congos, Gabun, Nigeria, both Sudans, Libya, Kenya, Djibouti, Tanzania, Somalia, Eritrea, Malawi, Mozambique, Zimbabwe, Swaziland, Lesotho, Benin, Liberia, Sierra Leone, Gambia, Western Sahara, Mali, Chad, Equatorial Africa
19. In the Pacific (3) most of the Island States are missing, as well as Antarctica.
20. The biggest gap of responses is from Asia (15) : The Arab States, Central Asia, Afghanistan, Pakistan, India, Bangladesh, Myanmar, Thailand, Indonesia, Timor Leste, North Korea.
21. The replies cover only about 50% of the land areas of the globe.
22. Also not covered are bathymetry and hydrography of the ocean areas, which cover about 2/3 of the globe.

V. Results of the Analysis to date

23. For the 91 countries and regions, which have replied, the analysis of the results by the Questions asked is as follows:

A) National Topographic Mapping Coverage

Question 1) Extent of existing Geodata or Map Coverage at various scale ranges

Most NMA's have only listed their coverages for the scales, for which they are responsible. No mention was made in some responses of the large scale coverage of urban areas under responsibility of the municipalities. This still needs to be locally verified.

Some NMA's have provided graphical indexes of their map coverage, and some have even indicated the last update of the maps, but the supplied data were inconclusive with respect to the data coverage in km² or in % of the national area.

Some NMA's have listed links to their web-sites. Most of these are in their national languages. Again it is very difficult to extract the desired information.

Nevertheless, a map was derived to show the available largest scale coverages of the countries, which have replied. See Fig.1 to Fig.4 for the scale ranges 1:25 000, 1:50 000, 1:100 000 and 1:250 000 with the percentage of coverage for each country, if available.

Since some countries did not submit the information with sufficient clarity or did not respond at all, another approach had to be taken for those areas. The Eastview Geospatial database for ordering international maps has been analyzed to derive an estimate of the map coverage at different scale ranges for the land areas of the globe. A distinction has been made in 3 categories: Fig.5 shows the coverages of maps at the largest available scale for maps produced by the country itself.

It is no secret that countries, which have or had global security concerns, did their own mapping of the globe. These were done by the US Defence Agencies and the Defence Agencies of the former Soviet Union. Their maps are now for sale by Eastview. Fig.6 shows the coverages at the largest available scale produced by the USA and Fig. 7 produced by the Russian Agencies.

Question 2) Current Age of Existing Geodata

Fig. 8 shows the average age of the largest map coverage for a country having given a report. Moreover, the Eastview database contains the dates of issues of the listed geodata and maps listed for a country or region not having submitted a report. This permits to assess the actuality of the available global map content at the largest available scale shown in Fig. 9.

Question 3) Restrictions on Map Data Distribution

In most countries the maps are freely accessible without restrictions (68 countries). Only 22 countries (out of the 90) have restrictions on maps for the public. (See Fig. 10)

Question 4) Sale of Maps

In most countries map data are for sale in analog and digital form. 39 countries have web distribution facilities and 51 have not. (See Fig. 11). Generally only small scale overview maps are available through the web.

In 77 countries maps in various forms are offered for sale. Only in 5 countries they are offered at no cost. (See Fig. 12)

Question 5) Updating Strategy

72 countries out of 90 update their maps. 15 countries do not have updating programs. 46 countries carry out updating by map sheets and 29 by features.

Question 6) Updating Methodology

The methodology of updating in 35 countries is by photogrammetry supported by field surveys in large and medium scales and from satellite images supported by field surveys and aerial imagery at small scales. 23 countries list a combination of photogrammetry and field surveys. 2 countries list field surveys only, 7 aerial images only and 3 satellite images only. 9 countries utilize crowd sourcing combined with other methods.

Question 7) Inhouse Capabilities of NMA's

50 NMA's have inhouse mapping operations, 13 practice outsourcing and 27 have both. (See Fig.13)

B) National Imagery Acquisition

Question 8) National Aerial Imagery Program

55 countries have a national aerial photography program, 33 do not. 50 countries use digital imagery only, 10 use traditional analog imagery only and 23 utilize both types.

7 countries have no own facilities. (See Fig.14)

Question 9) Satellite Imagery Uses by NMA

74 NMA's use satellite imagery for mapping. 17 countries do not.

Question 10) Use of Radar or Lidar

Radar imagery is used in cloud prevalent countries, and Lidar in most developed countries. Developing countries have not introduced this technology. Altogether 46 countries use radar or lidar sensors, 44 do not. (See Fig.15)

Question 11) Lidar DEM

Lidar is used for DEMS mainly in the developed world. 46 countries use it for DEM Generation.

Question 12) Orthophoto Program

Orthophoto technology is generally used in 82 countries to bridge the time gap for map updates. Only 8 countries do not use it. (See Fig.16)

Question 13) Interest in 3D technology by NMA

45 country NMA's are interested in 3D modelling information for viewing urban landscapes, 45 are not. (See Fig.17)

Question 14) National DEM

National DEM's are established in 64 countries, in 26 countries not.

C) National surveying and cadastral coverage

Question 15) Licensed Surveyors

75 countries have licensed surveyors for property surveys, 15 have not. (See Fig.18)

Question 16) Responsibility for Cadastral Mapping and Cadastral Map Coverage

A national cadastral map coverage is available in 17 countries, but not in 29 countries.

Only 41 NMA's have the responsibility for the real estate cadastre. 49 have not. (See Fig.19)

Question 17) Use of Cadastral Maps

The use of cadastral maps is generally for securing titles (45), for taxation (39), for land registration (50), for conveyancing (36) and for other reasons (17).

Question 18) Cadastral Maps and Geodetic Control

In 77 countries cadastral maps are based on geodetic control, in 13 not.

Question 19) Monumentation of Property Boundaries

In the majority of countries (65) property boundaries are monumented in the field, in 24 countries they are not. (See Fig.20)

Question 20) Updating of Cadastral Maps

Updating of property maps in 68 countries is done by transaction procedures, in 22 countries this is not linked to transactions.

Question 21) Number of Cadastral Employees

The number of employees or private surveyors engaged in cadastral operations is usually much larger than the personnel engaged in topographic surveys.

D) Organisation

Question 22) National Funding for Mapping

Topographic mapping is nationally funded in 80 countries, in 10 not.

Question 23) Mapping Budget

Some countries list their budget and this is proof that mapping is a very substantial highly regarded operation.

Question 24) NMA staff

The number of staff engaged in mapping in the developed countries exceeds the number of staff in the developing countries.

Question 25) Legal Status of Mapping

In most countries (77) NMA's have legal or regulatory status, in 11 countries they have not.

Question 26) Form of Map Products Supplied

Even in developing countries the supply of digital map data exceeds that of analog products. Online and web delivery of map data is generally only available in developed countries. 56 countries list hard copy maps as possible output, 55 digital media, 31 downloads and 29 the web.

Question 27) Archival of Geodata

All countries care about archiving their map data in analog or digital form. 37 list servers, 53 do not. They use more conservative media. (See Fig.21)

VI. Discussion

24. Another access database has been created by ISPRS to compare the results of the current 2012 GGIM study data with the data of 1986 published in World Cartography XX, 1990.

To compare the country data between 1986 and 2012 it is necessary to relate the areas of the countries of the world to the current status, as some countries have merged (e.g. Yemen) and some have split (Sudan – South Sudan, Serbia –

Kosovo). This is no problem, if the data for mapping coverage are available for each scale at a km² basis.

25. The UNRCC Resolution 3/IX of E/Conf 99/3 New York 2009 recommended that the study should take into consideration official national mapping agencies, other institutions, and the private sector, including both the status of technological and legal issues pertaining to geospatial data.

26. In this regard ISPRS has established contacts to the following private sector institutions, in the hope that they will communicate for the purpose of the study their acquired imagery and mapping coverages:

- Google Earth and Google Maps (imagery and maps)
- Microsoft Bingmaps (imagery and maps)
- TomTom (road features)
- Navteq (road features)

27. ISPRS has also established contacts to the commercial map providers

- Eastview Geospatial, Minneapolis, Mn., USA
- ILH Stuttgart, Germany

These companies provide internationally available maps for sale including map indexes which can help to verify the information obtained in the surveys and permit to supplement missing data.

28. The questionnaire survey conducted by the GGIM Secretariat has not only provided the requested data, but the questionnaires have also identified discussion partners, with whom it will be possible to clarify the desired information, so far missing and to verify mutual misunderstandings in answering and evaluating the responses. This task is to be undertaken next before a next version is to be presented to the UNGGIM Expert Meeting in Cambridge, England in July 2013.

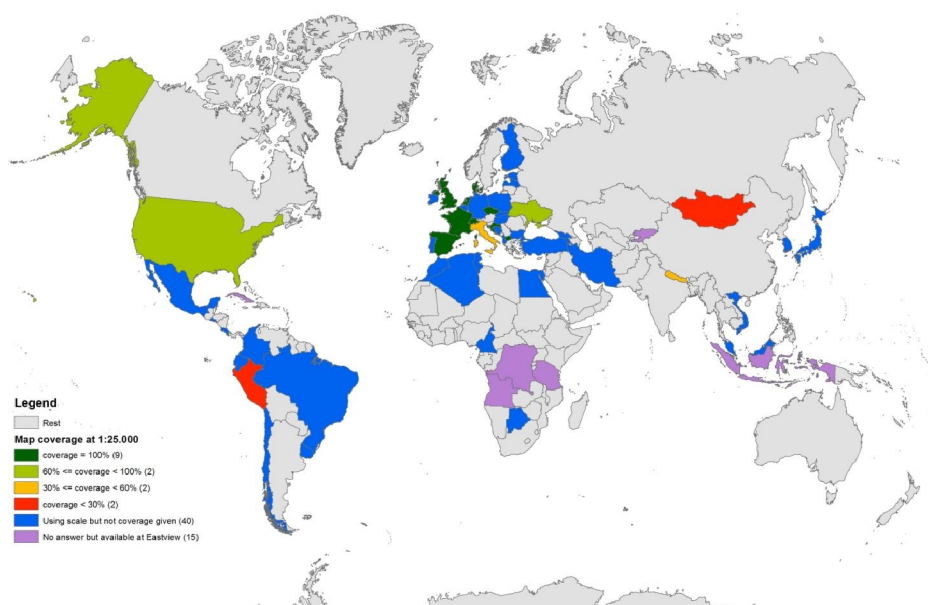


Fig. 1 Coverage 1:25 000 maps with percentages

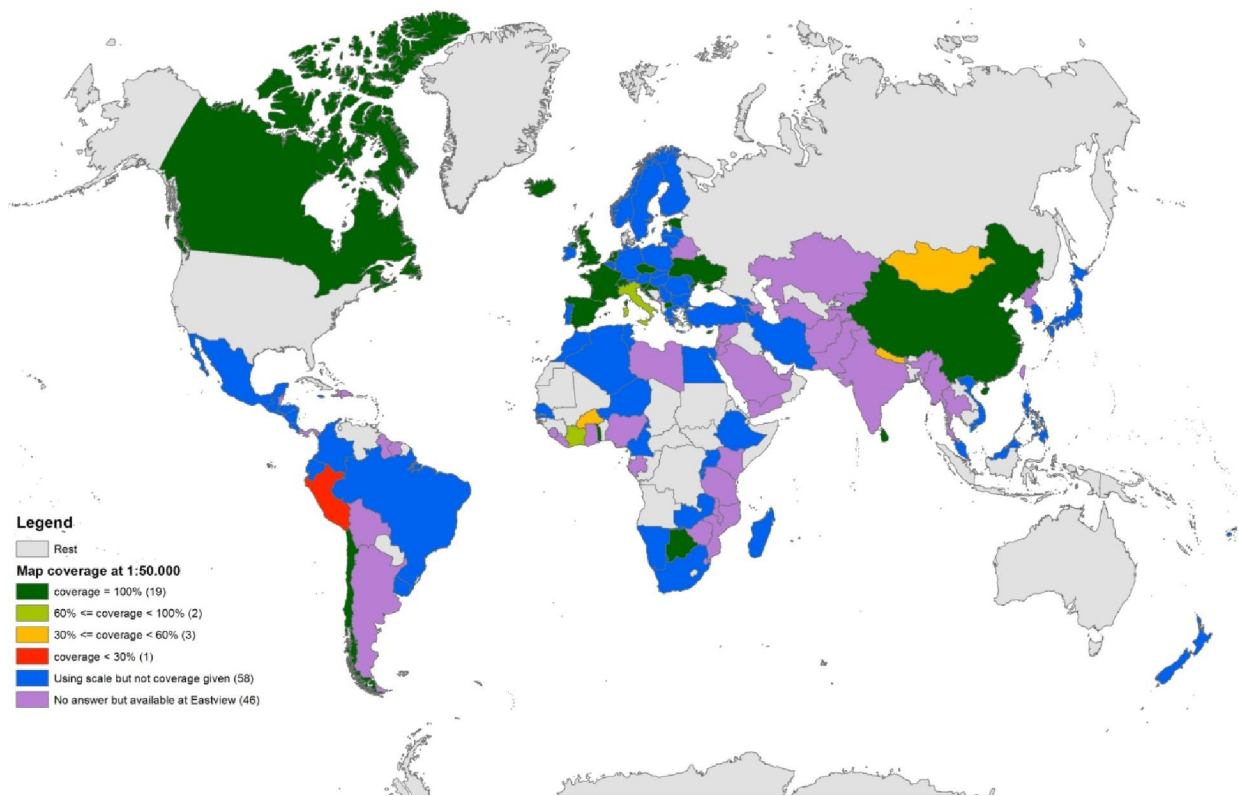


Fig. 2 Coverage 1:50 000 maps with percentages

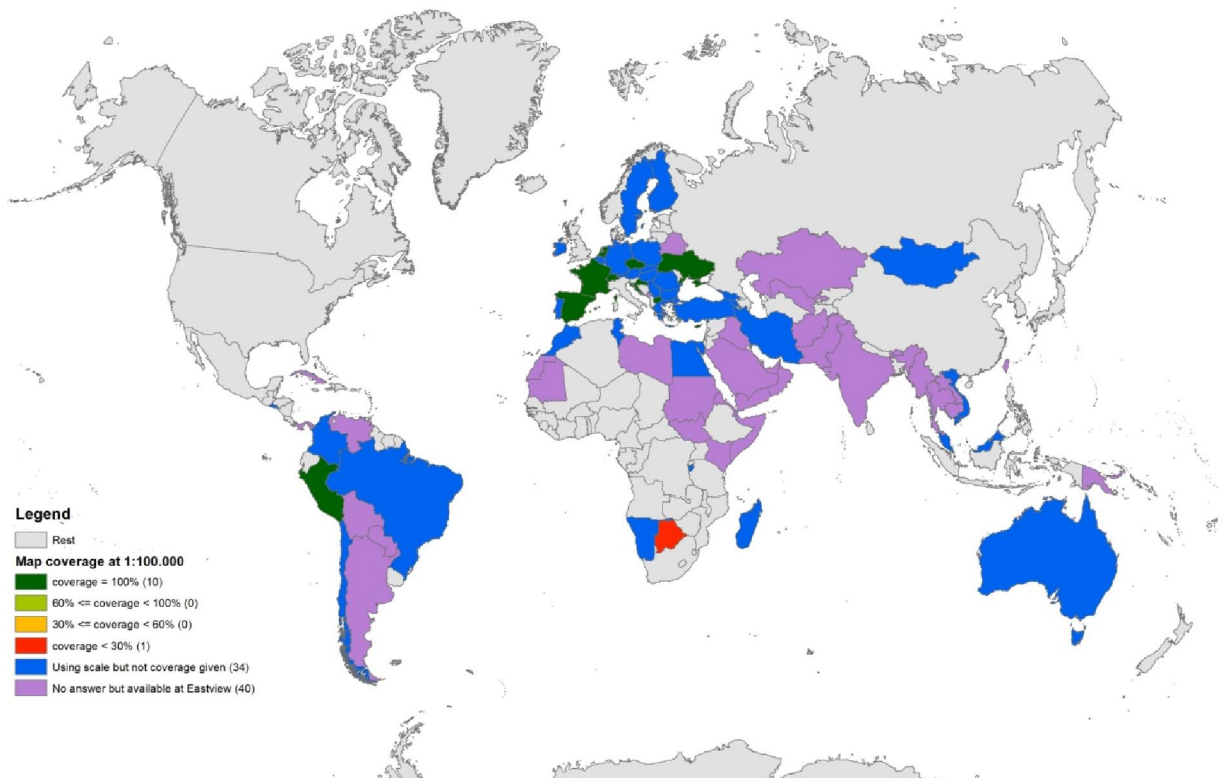


Fig. 3 Coverage 1:100 000 with percentages

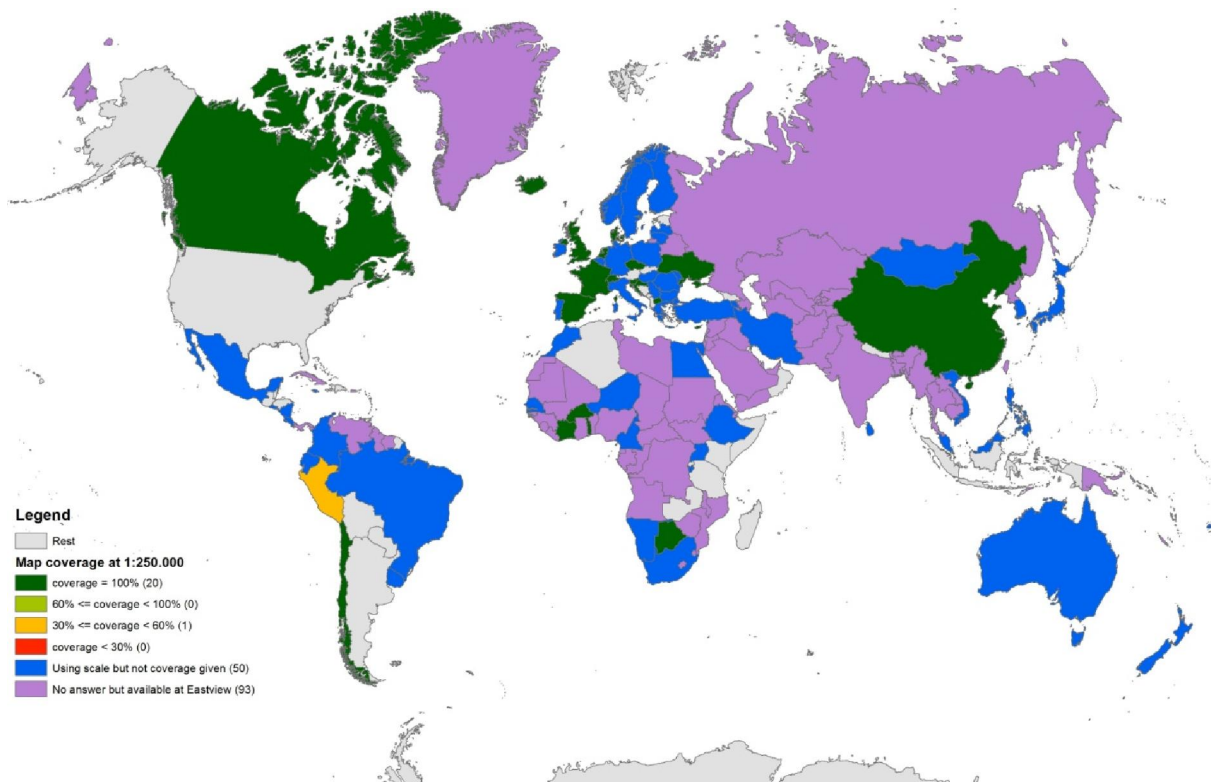


Fig. 4 Coverage 1: 250 000 with percentages

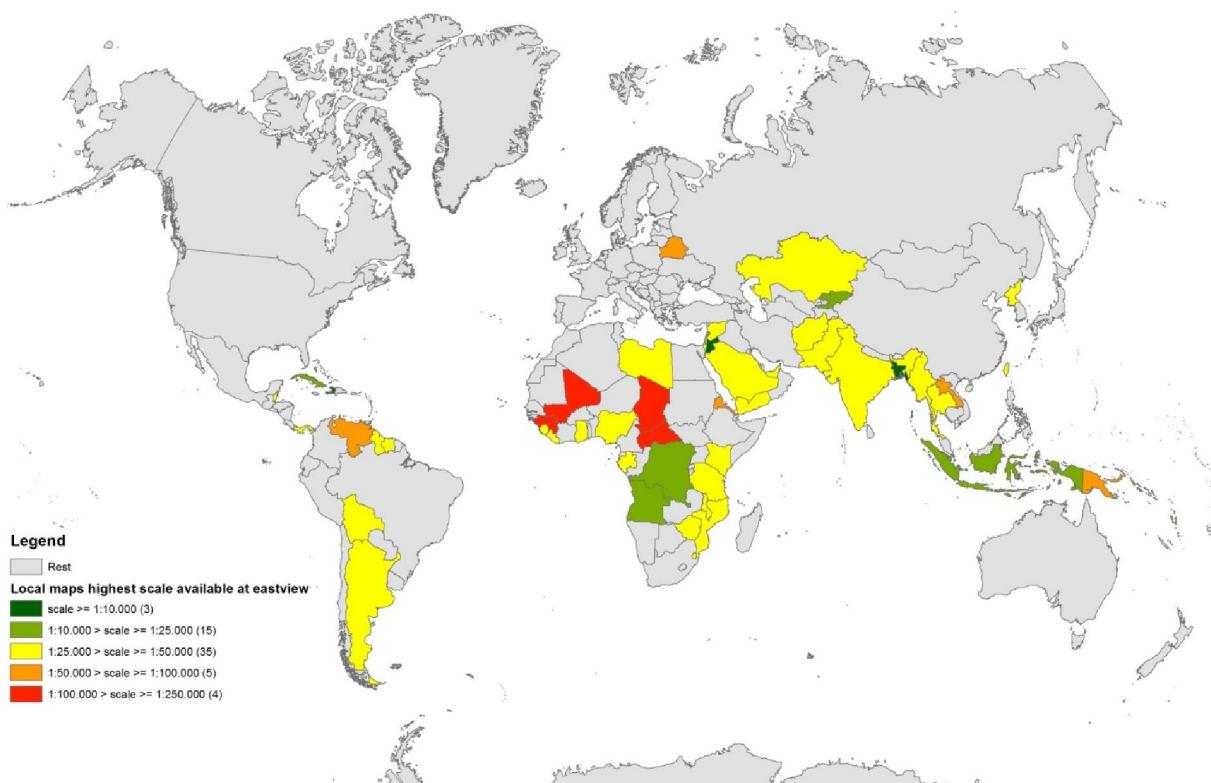


Fig. 5 Availability of Locally Produced Maps from Eastview Geospatial at scales 1:10 000 to 1:250 000

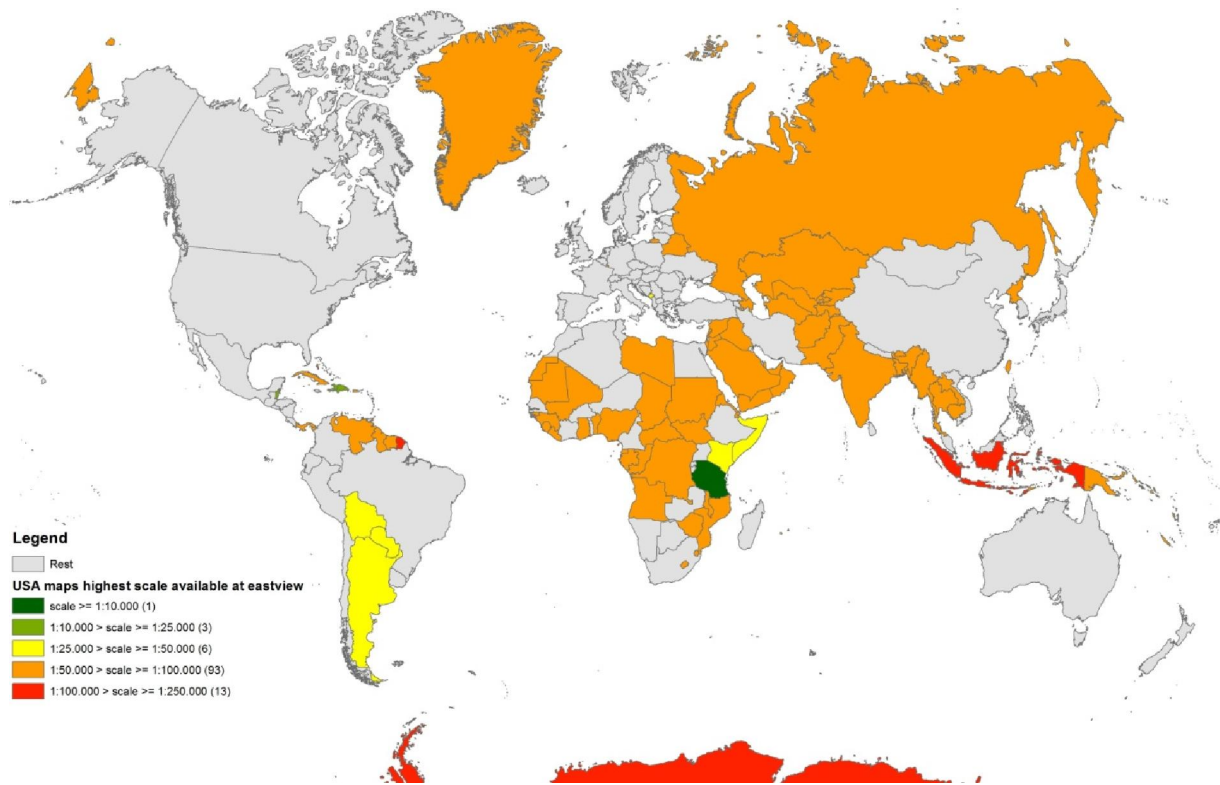


Fig. 6 Availability of US Produced Maps from Eastview at scales 1:10 000 to 1:250 000

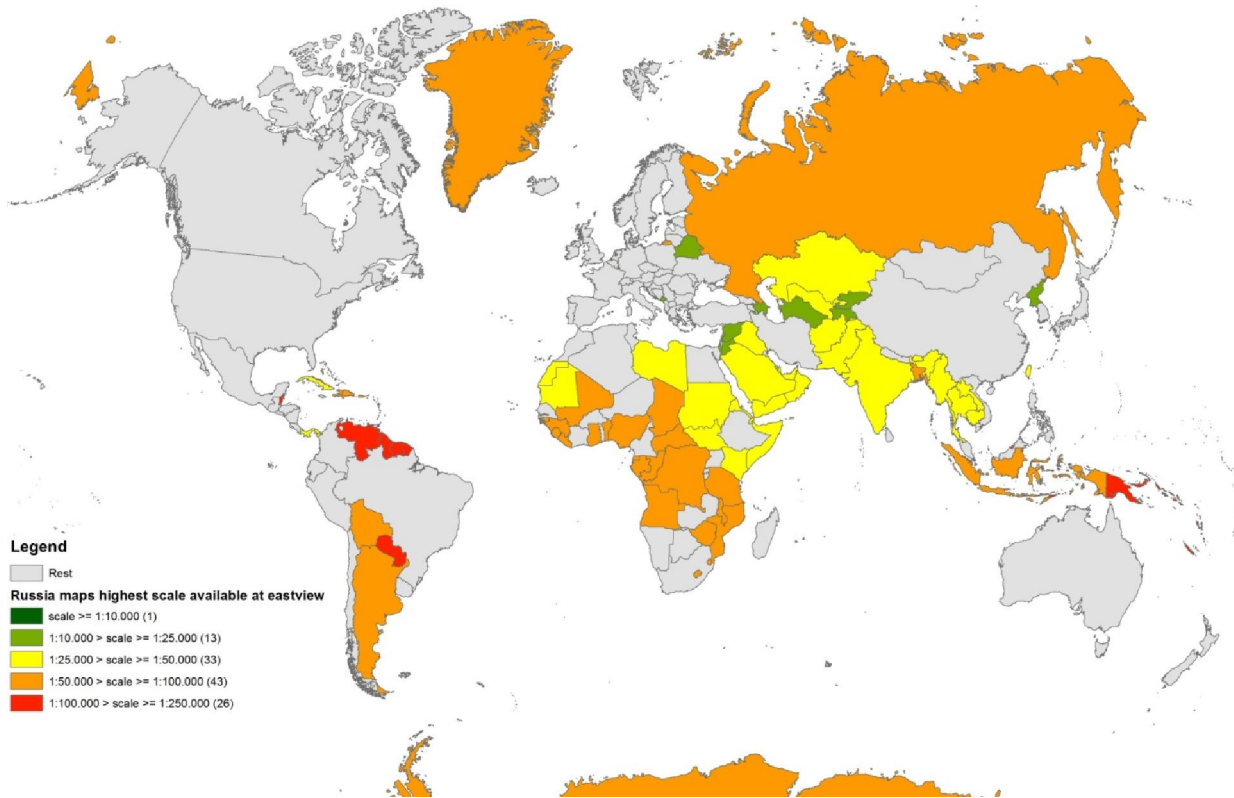


Fig. 7 Availability of Russian Maps at Eastview at 1:10 000 to 1:250 000

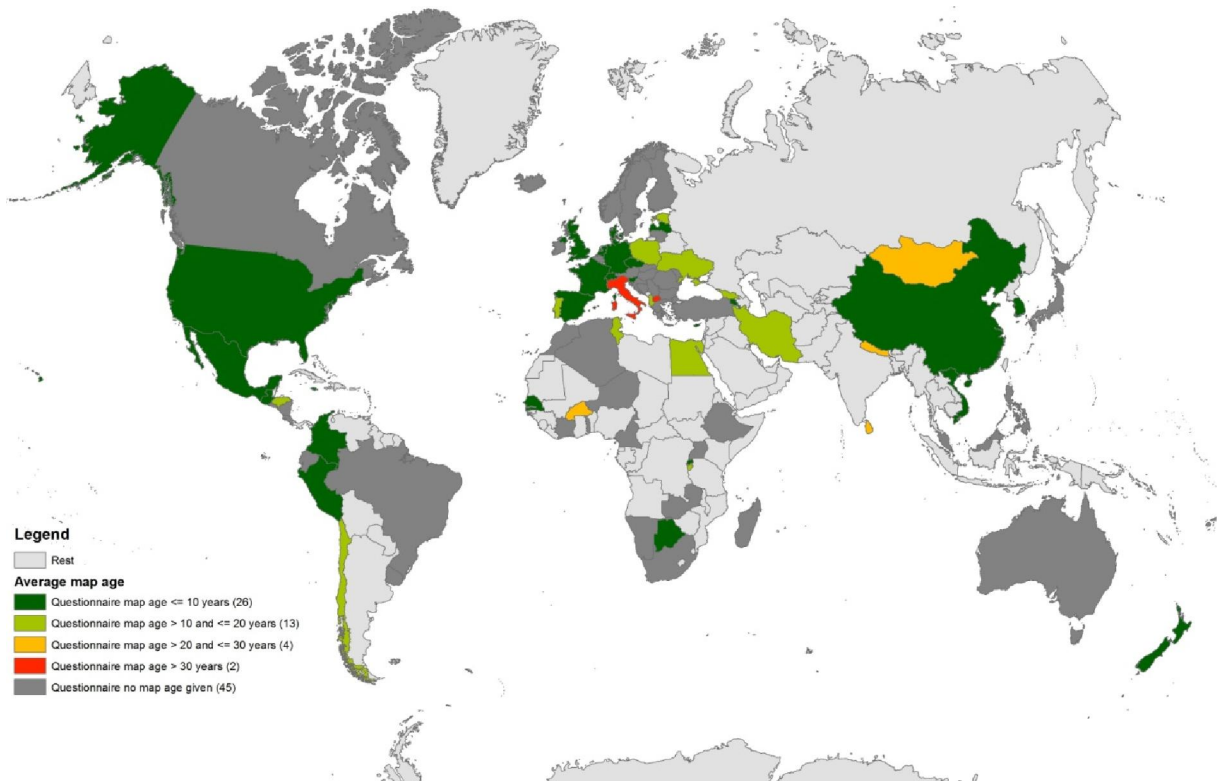


Fig. 8 Map Age from Questionnaires for largest scale cover

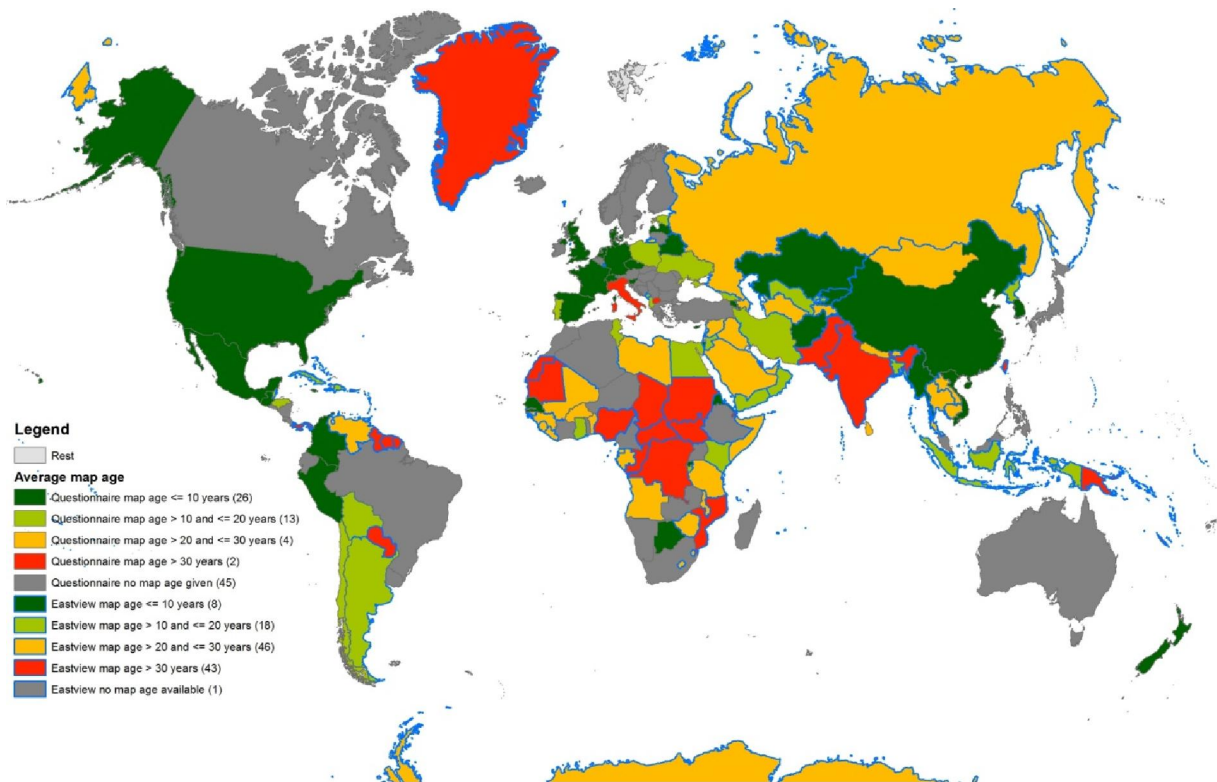


Fig. 9 Age of largest scale cover maps from Questionnaire and Eastview data combined

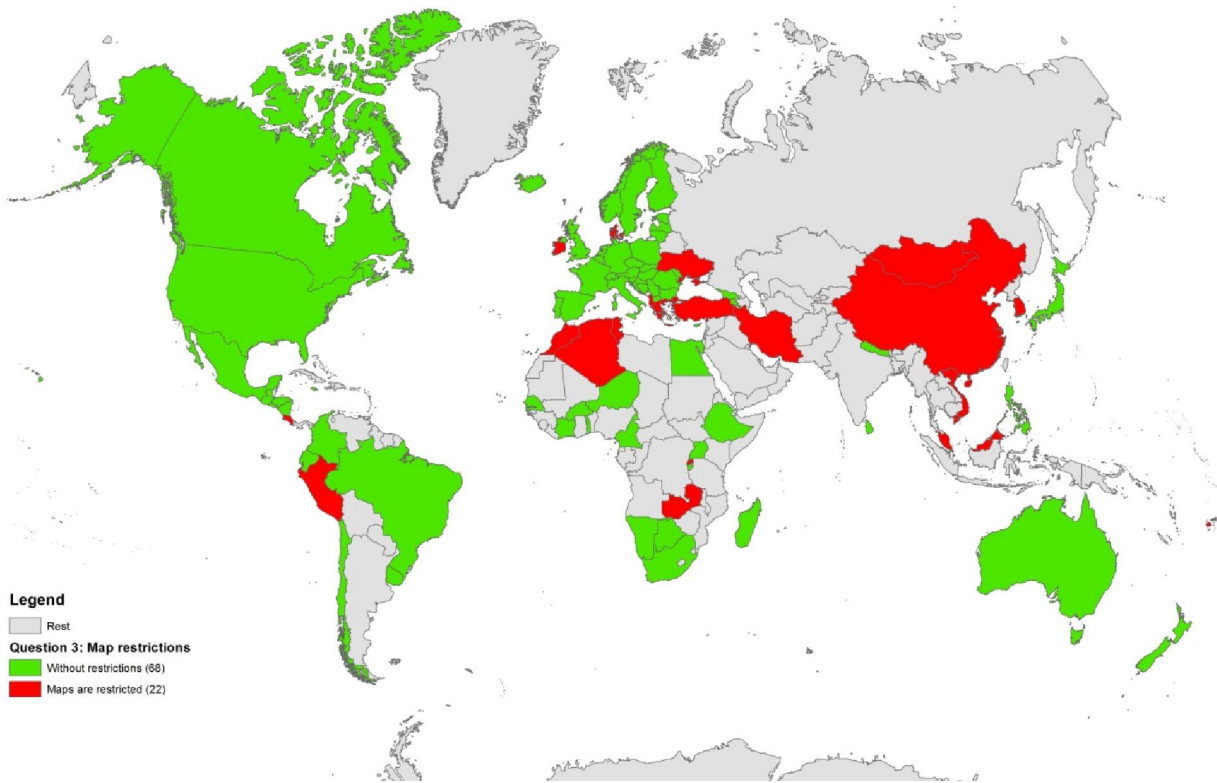


Fig. 10 Map Restrictions

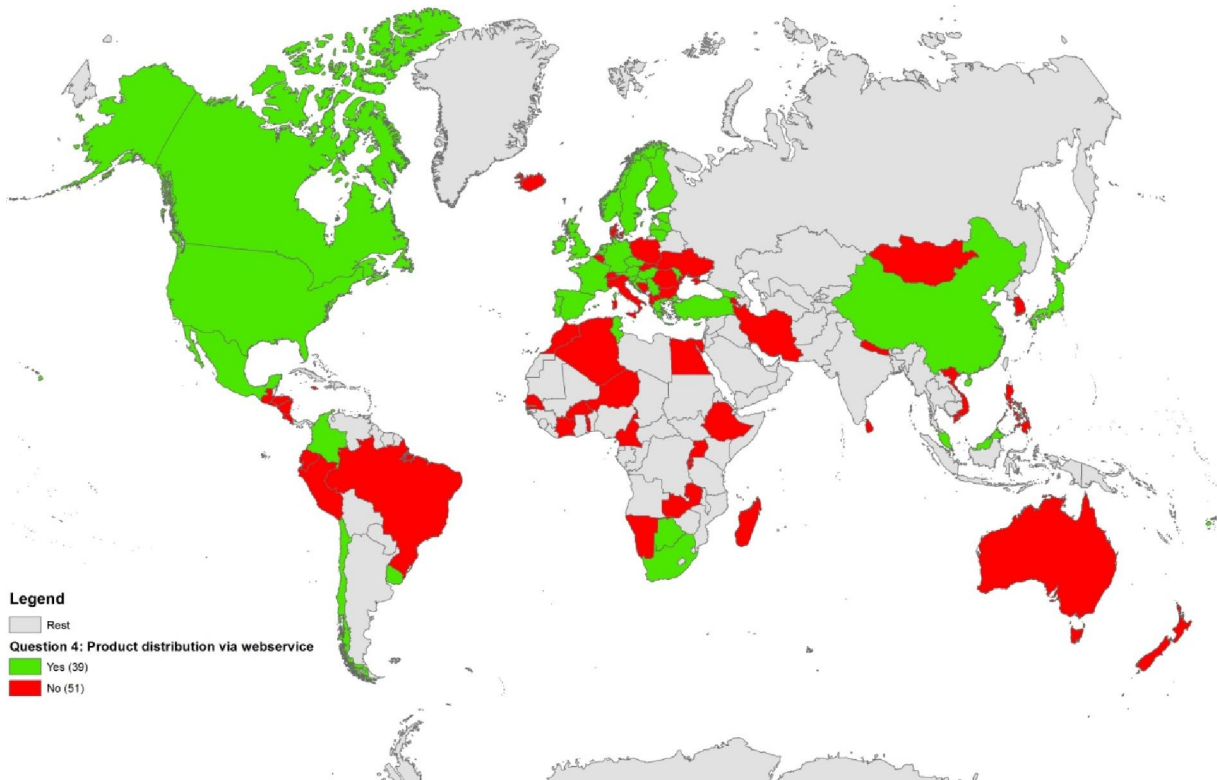


Fig. 11 Map distribution by web

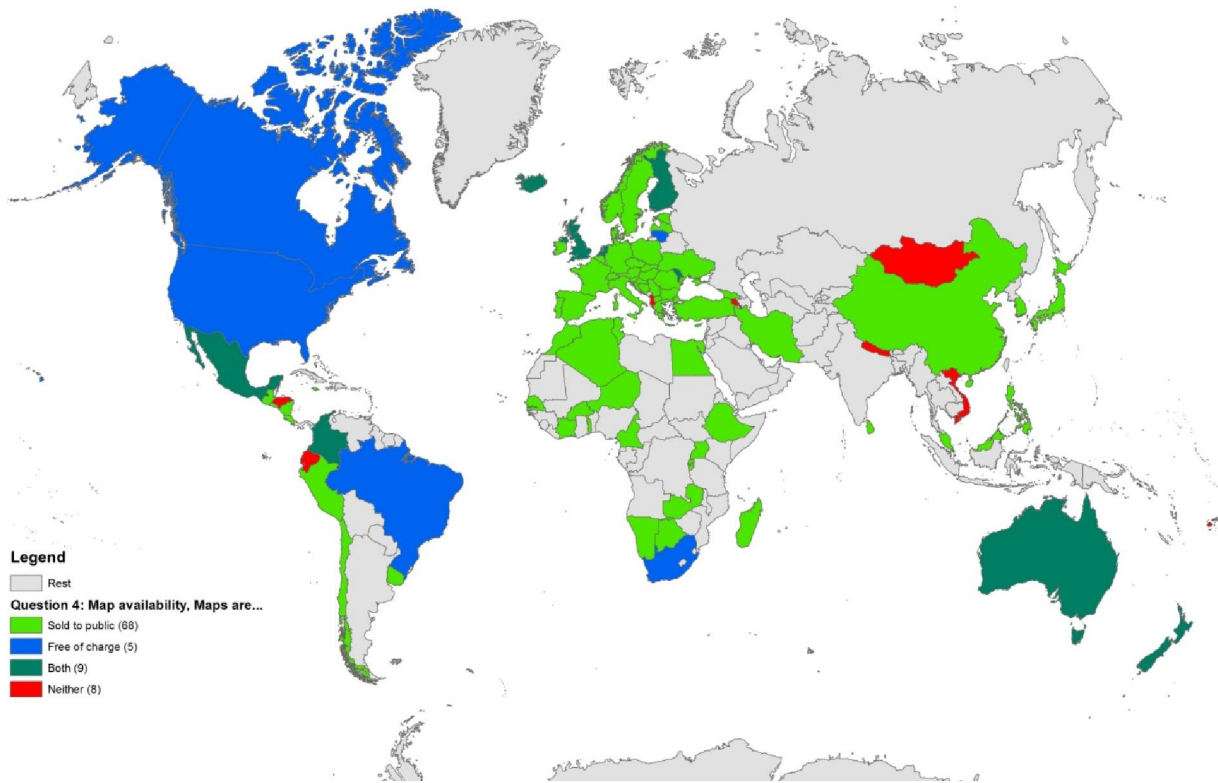


Fig. 12 Map Availability for sale or free of charge

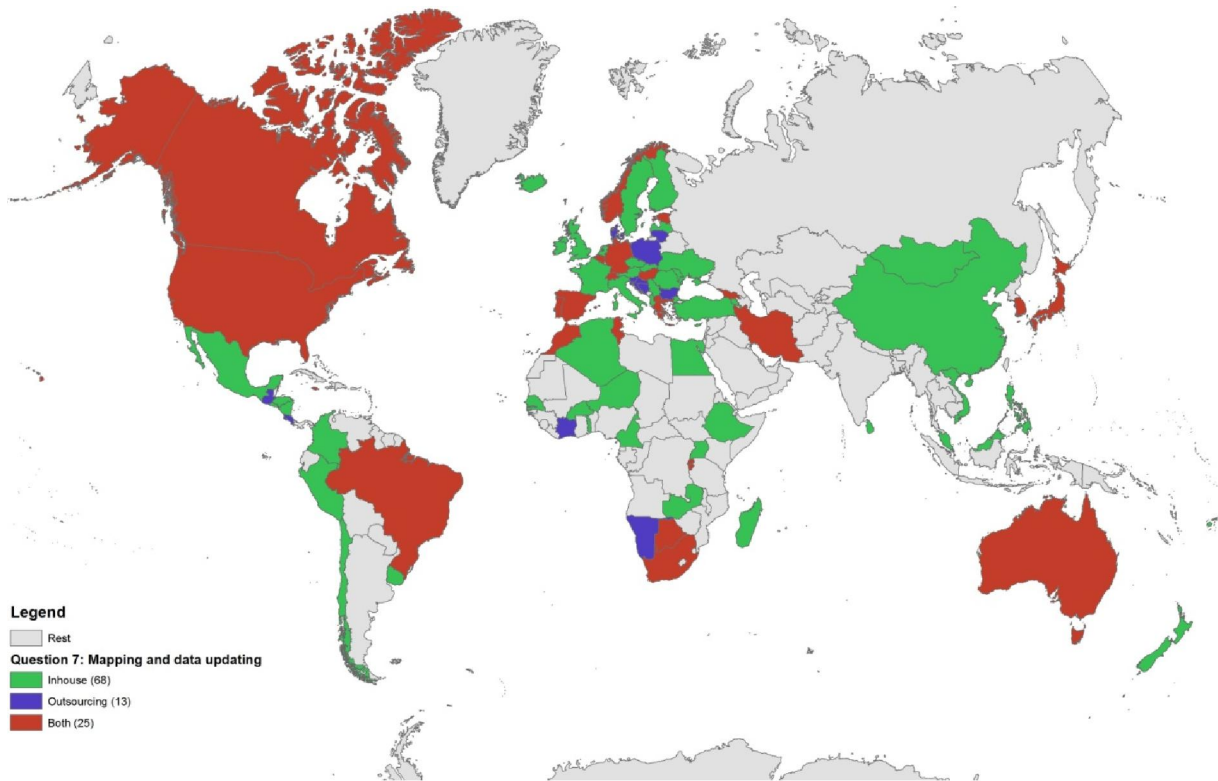


Fig. 13 NMA In-house Operation or Outsourcing

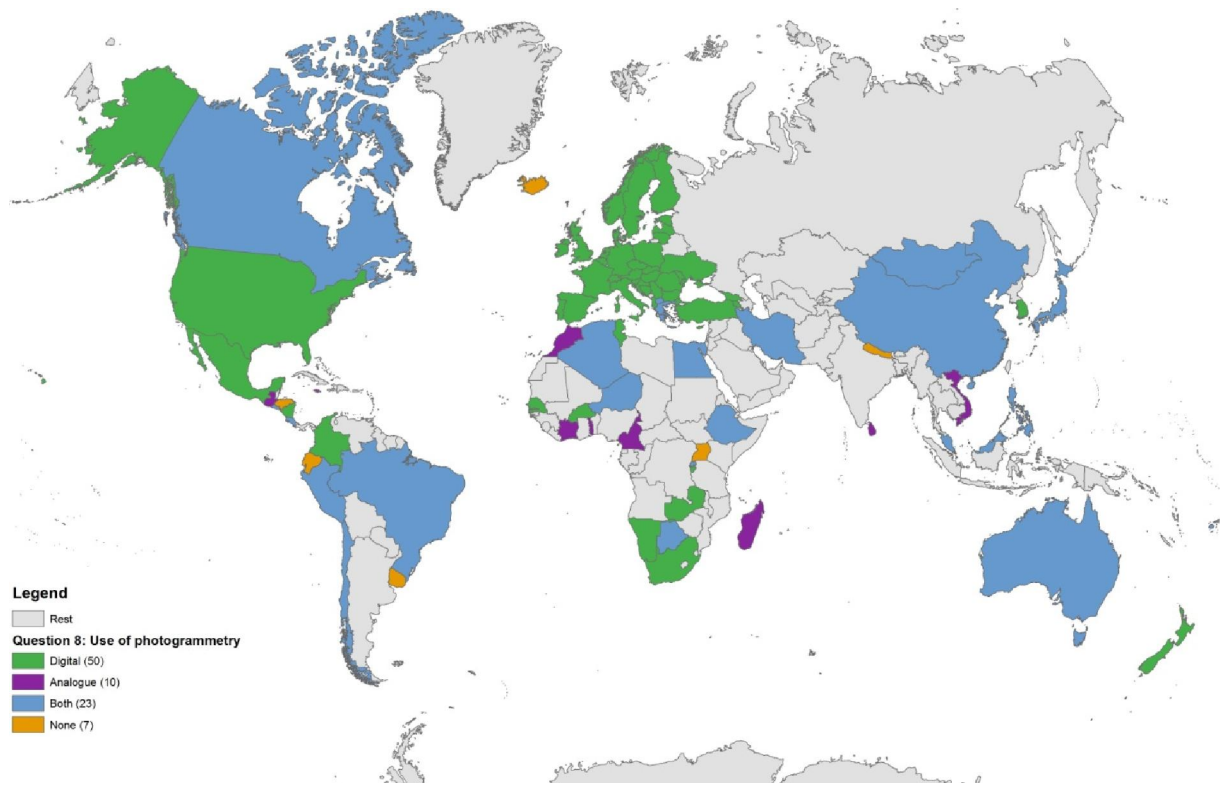


Fig.14 Digital or Analog Photogrammetry Use

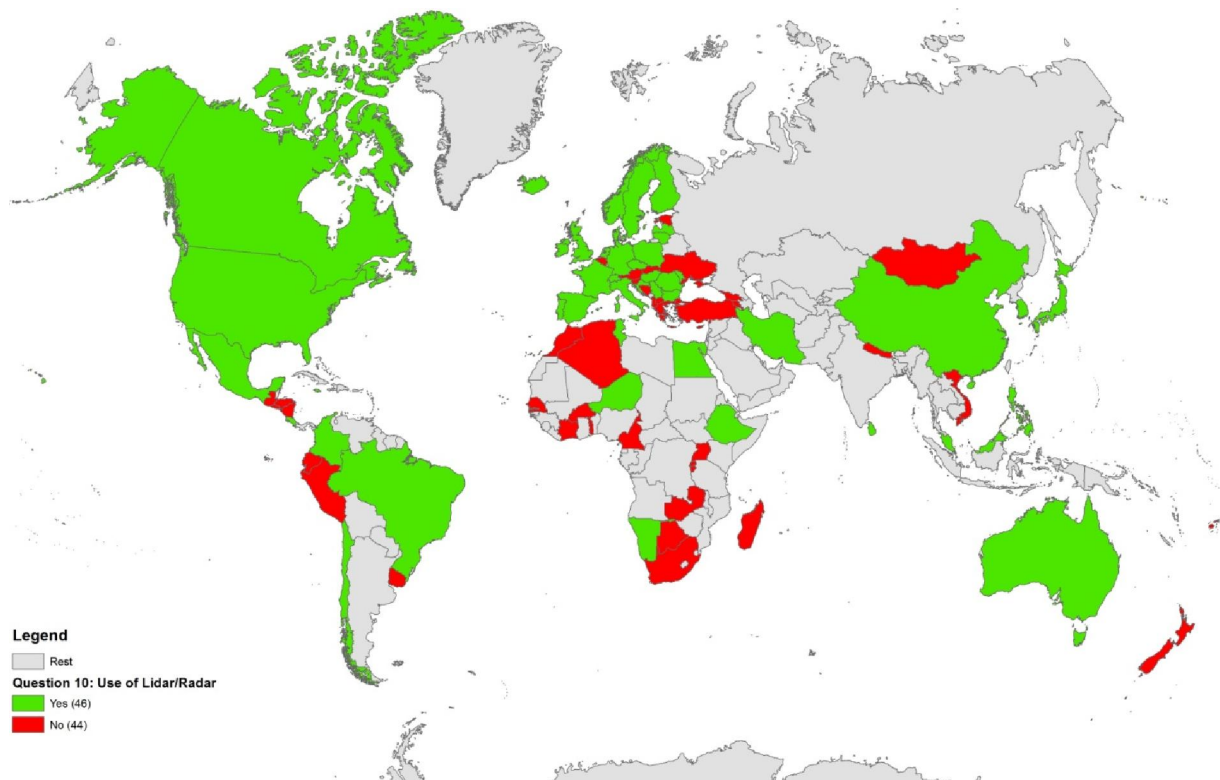


Fig. 15 Radar and Lidar Uses

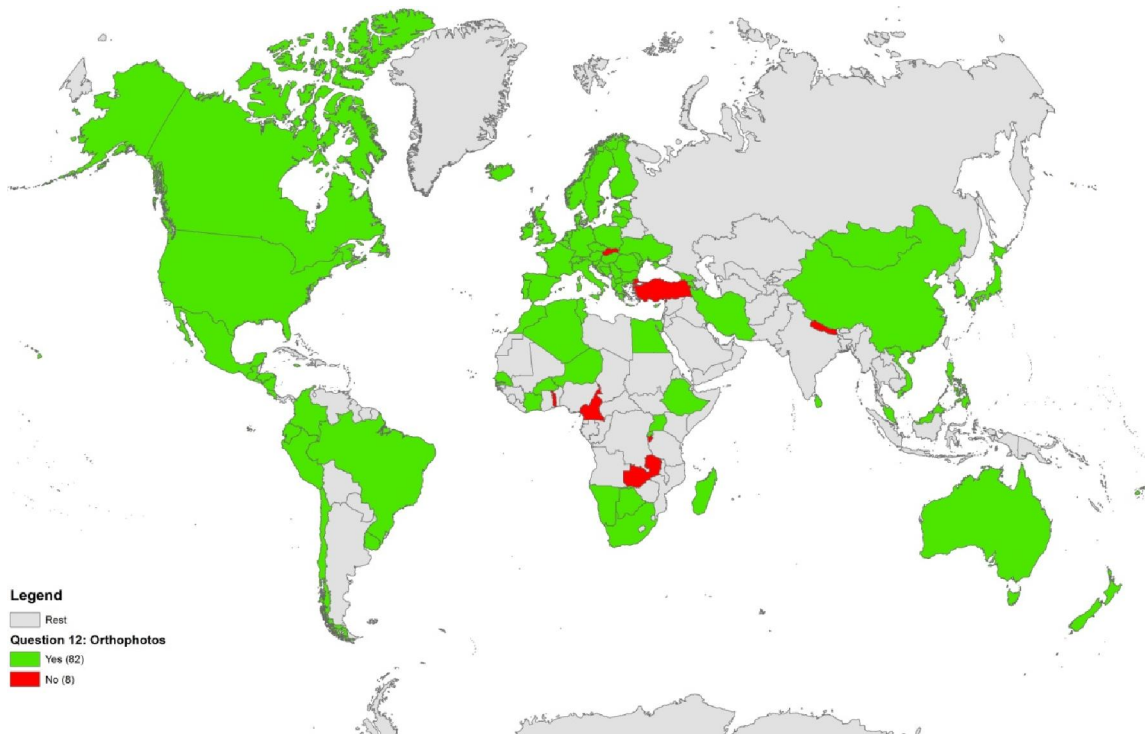


Fig. 16 Orthophoto Programs

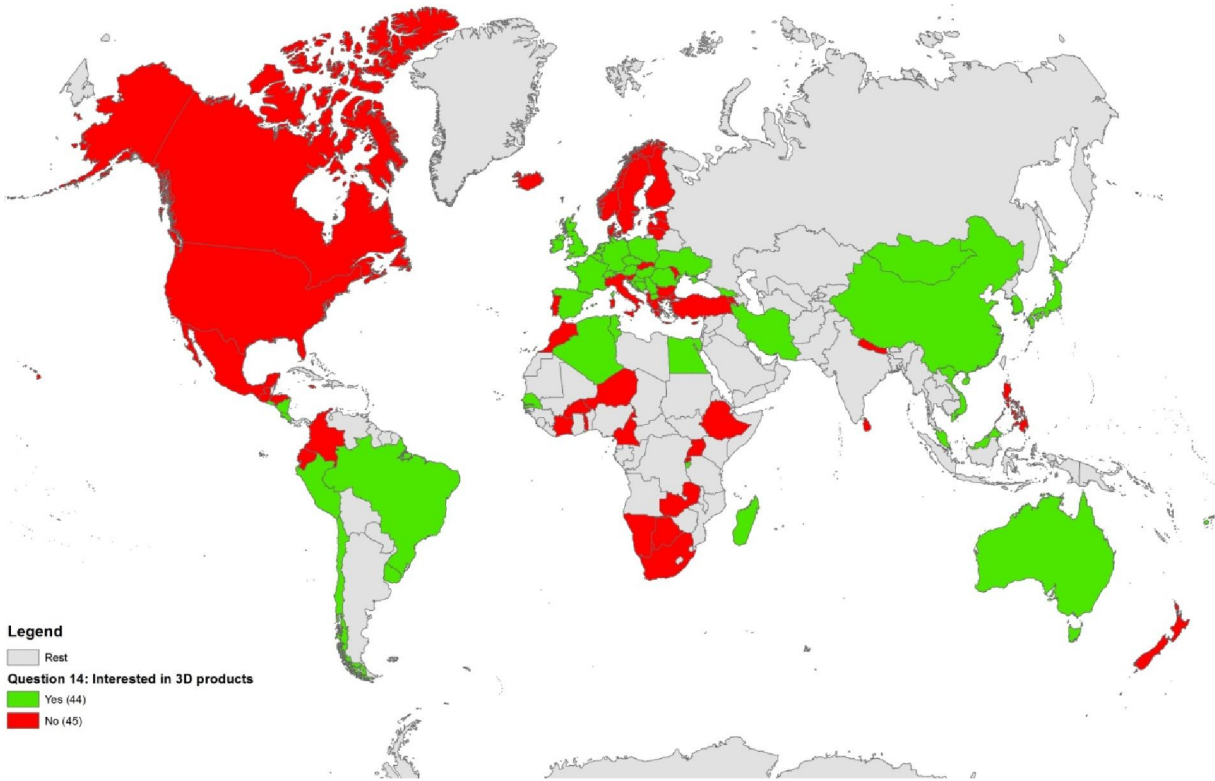


Fig. 17 NMA Interest in 3D

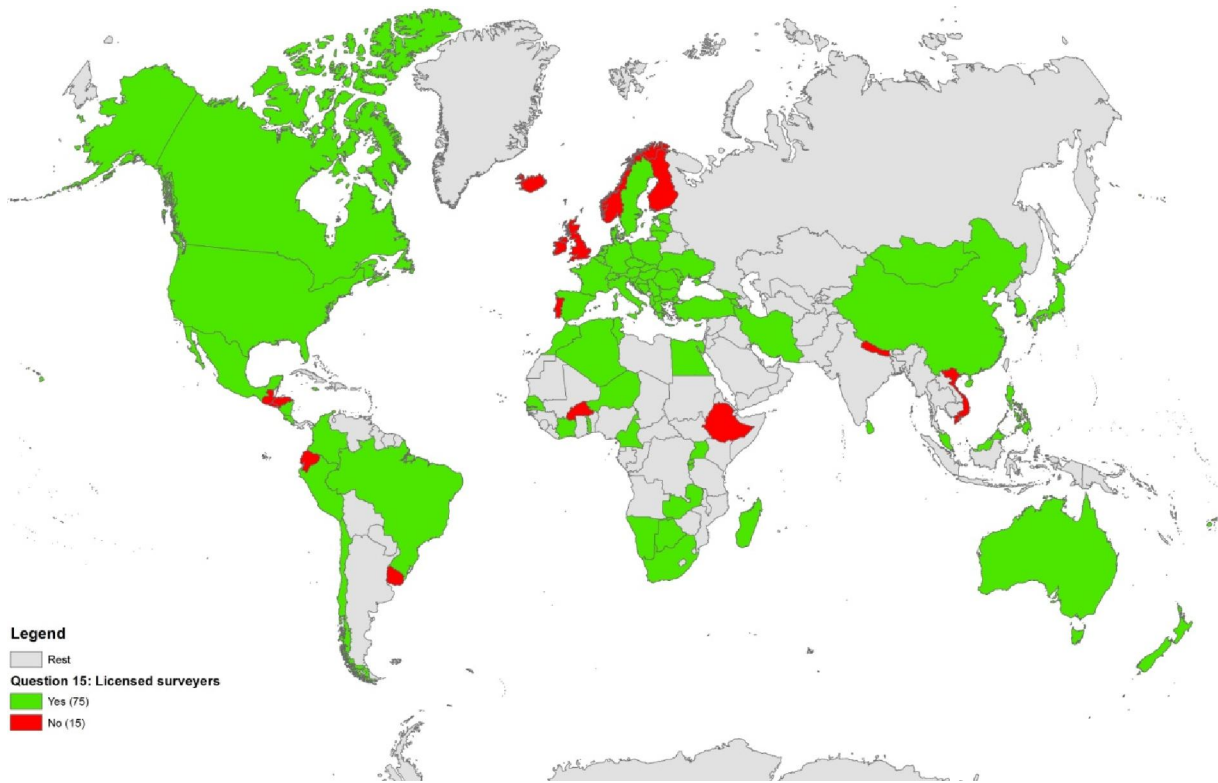


Fig. 18 Licensed Surveyors

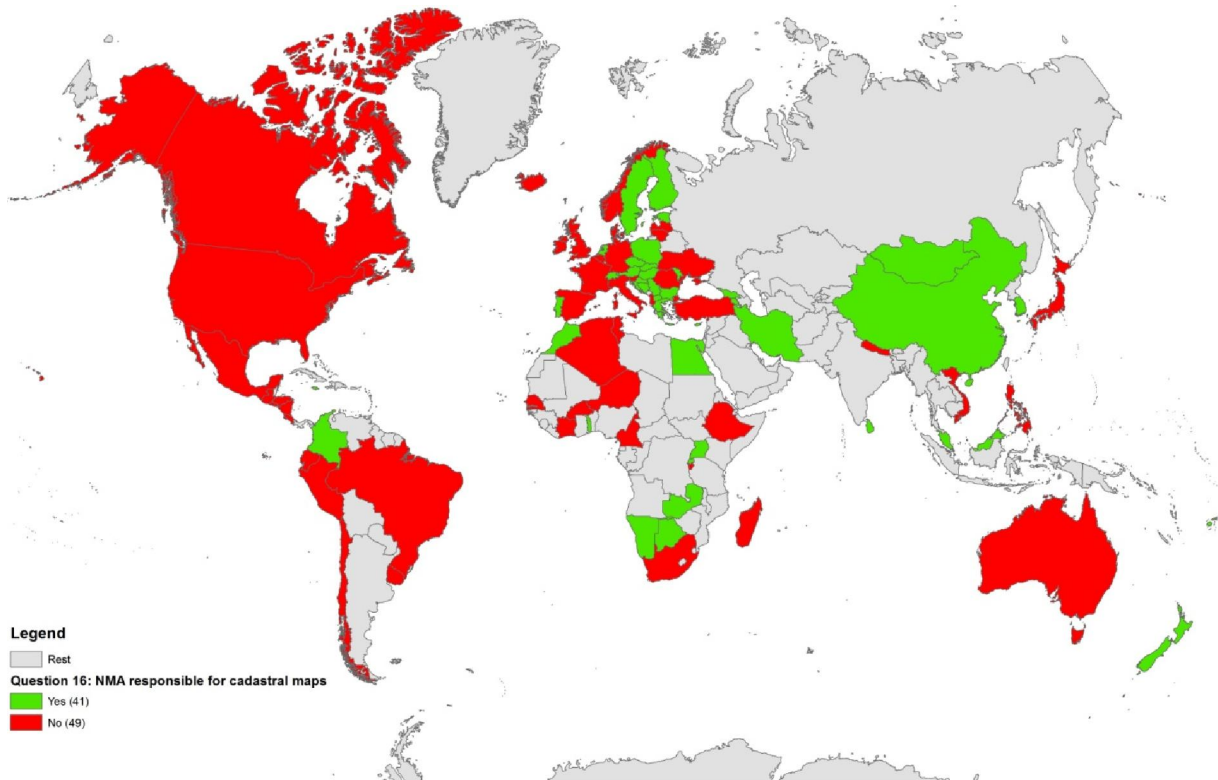


Fig. 19 NMA responsibility for cadastre

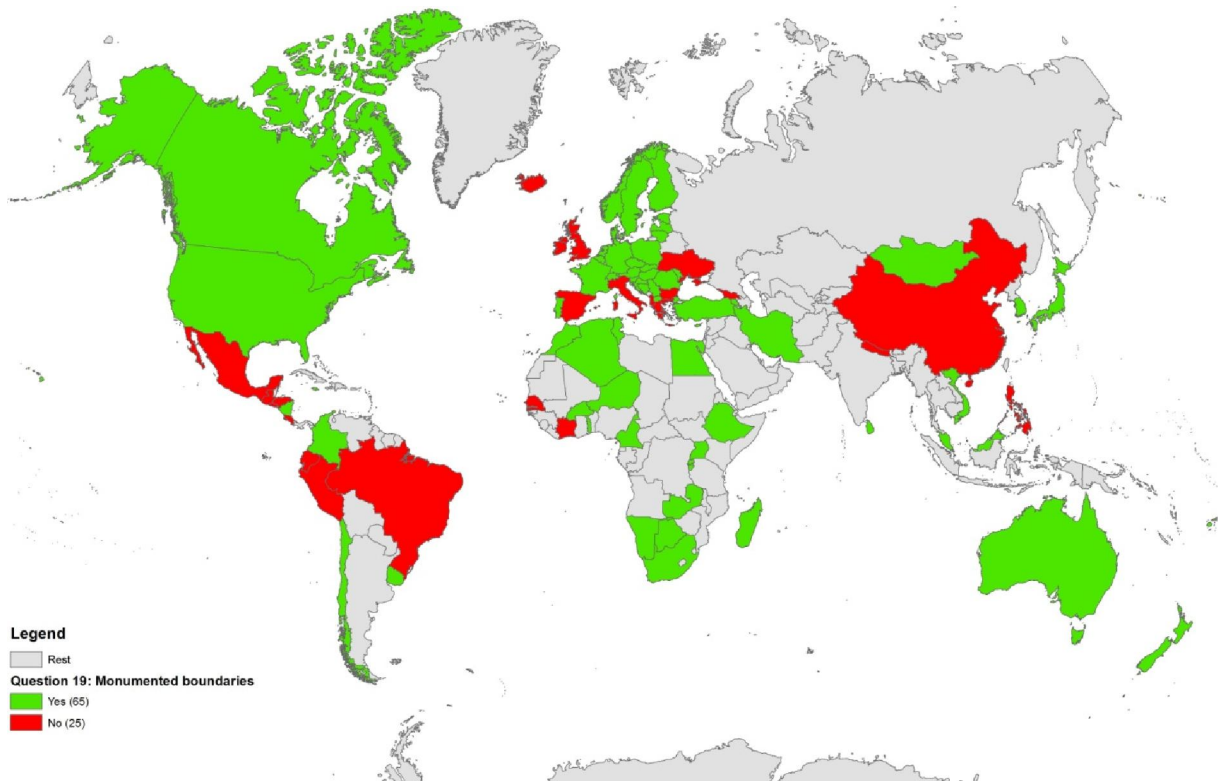


Fig. 20 Monumentation of Property Boundaries

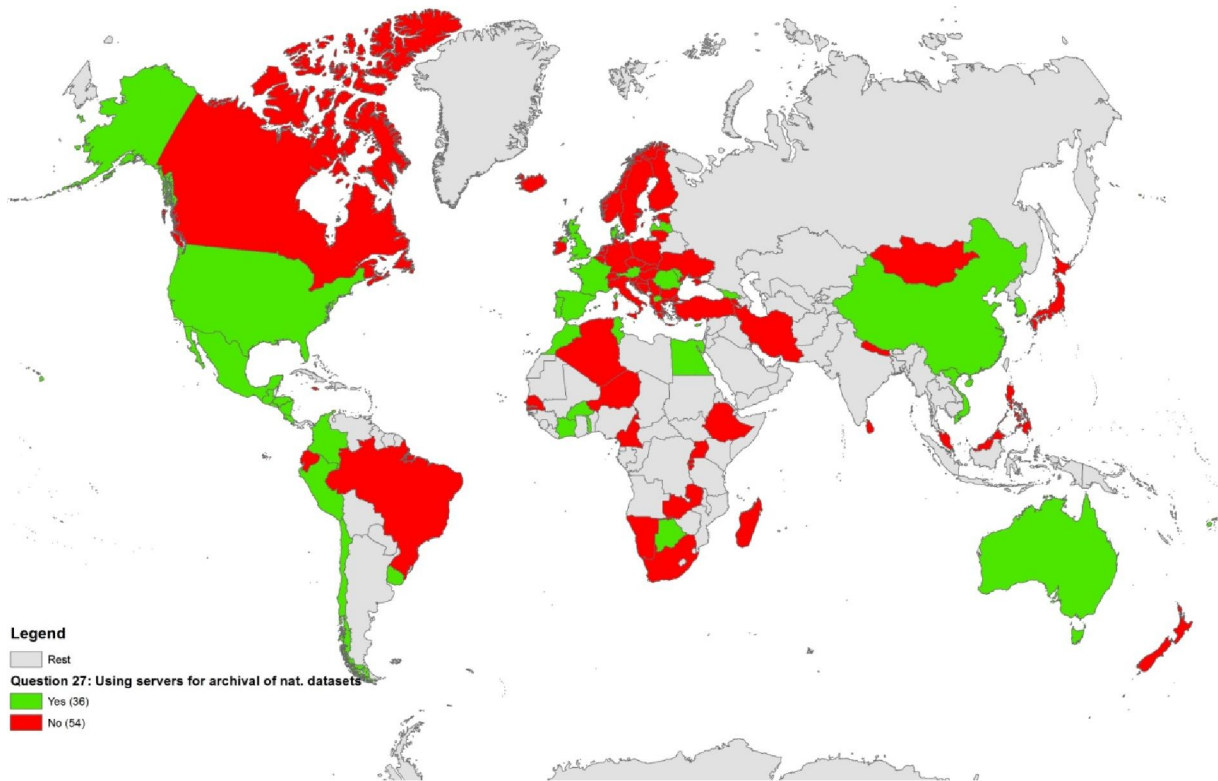


Fig. 21 Use of Servers for Map Archival

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