

Advances in Satellite Image Mapping: ITC's experience

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Abstract

This paper describes some of the observations and experiences of staff at the International Institute for Geo-information Science and Earth Observation (ITC) regarding the possibilities in theory of Satellite Image Maps (SIMs) and the practical applications of SIMs we see in the world around us. The first part will deal with the theory: What are SIMs in ITC's vision, what are their uses and possibilities? Next comes the practice. For this, an inventory of topographic SIMs worldwide has been made to determine what products are 'out there', what are SIMs used for and how in the world around us?

Introduction: MACRES & ITC

Both MACRES and ITC have a relatively long history in their involvement in SIMs and also a tradition of co-operation. The Malaysian Centre for Remote Sensing (MACRES) in Kuala Lumpur is currently developing a series of Satellite Image Maps (SIMs) to cover the whole of Peninsular Malaysia at scale 1:50,000. In order to efficiently compile accurate SIMs, an organisation requires both a modern integrated production system and suitably trained multi-disciplinary staff. For guidance on the production techniques and training, MACRES staff members came for a six week period to the International Institute for Aerospace Survey and Earth Sciences (ITC) in early 1998. There they followed a tailor-made combination of courses and workshops, during which the MaCRoS staff receives specialised training in the theoretical aspects of SIMs while at the same time developing workflows and producing a test-sheet for the intended map series. Following this, in 2001 there has been a five-week tailor-made professional attachment in Web Cartography.

The International Institute for Geo-information Science and Earth Observation (ITC), based in Enschede (the Netherlands), has over 50 years of experience in the field of training in a wide range of disciplines related to the Earth Sciences, Land-use Mapping, and Geoinformatics. At the ITC, knowledge of geoinformation management is amply available, and continually being developed and extended. By means of education, research and consulting, ITC contributes to capacity building in the developing world. ITC's core mission is to transfer knowledge by providing training and education to developing countries. In addition, ITC strengthens the productive, innovative and management capabilities by knowledge development using geographic information.

The yearly registration at this moment is over 400 students, over the last 50 years totalling >14,000 students from >160 countries. They have an average age of 34 years and their average duration of stay is 14 months. ITC has roughly 275 scientific & supporting staff. Our 6 educational programmes are geared towards mid career professionals from developing countries. Education at ITC is organised in regular courses at the Master of Science level (MSc - 16 months), at the Professional Master level (PM - 12 months) and at the Diploma level (9 months). Next to those, there is the possibility to follow modules on demand, there are PhD students and of course we offer tailor-made courses, such as the before-mentioned attachments for MACRES.

The theory: ITC's vision on satellite image maps

In ITC's teaching and consulting programmes, image maps are a frequently subject, whether as a means of obtaining information or a visualisation product to be produced. Our definition of what image maps are is "Image maps are remote sensed images which have been cartographically enhanced to make them readable, understandable and measurable". The keywords here are "remote sensed images" and "(carto)graphically enhanced". The first means that the image base can range from uncontrolled aerial photographs to georeferenced digital satellite imagery. The second means that they are not the raw image alone, that in itself is not an image **map** yet. As a minimum, the image needs to be geometrically rectified and corrected, but also some degree of cartographic symbolisation and added marginal information is necessary. This leads to a large variety of image maps, from simple black & white controlled photo-maps, where only co-ordinate information has been added to large variety satellite false-colour image map that are geo-referenced and which have toponyms added. Using this definition, **satellite** image maps (SIMs) can be defined as a narrowed down version of image maps: "Satellite Image Maps are satellite images which have been cartographically enhanced to make them readable, understandable and measurable". Here the image base is always georeferenced digital satellite imagery.

Image component: image sources

The source for the image component is mostly coming from Earth observation satellite imagery, such as Landsat Thematic Mapper (TM), SPOT multi-spectral (XS), SPOT panchromatic (pan), IKONOS, QuickBird, KVR, IRS, etc. But also other 'optical' satellites sensors, such as NOAA, MeteoSat, Spaceshuttle, etc., can be used and even non-optical sensors, such as radar, laser, etc. can be useful sources for SIMs.

Image component: single or combined

Data from the before-mentioned image sources can be used as single images, as image mosaics or as image fusion products. Image mosaics involve combining several images of one sensor into a larger whole, whereas image fusion involves combining several images of different sensors. A much used example of this is to combine the spatial resolution of SPOT-pan with the spectral resolution of Landsat-TM, using Intensity-Hue-Saturation transformation techniques.

Cartographic enhancements

The cartographic enhancements used on the images resulting from the before-mentioned image base, have the important goal of making the image better readable, measurable and understandable. The first involves techniques like radiometric corrections and image enhancement, ranging from simple colour composites to visualisation for simulating natural colours. The SIM can be made measurable, first of all by the use of geometrically corrected and geo-referenced images, and secondly by stating information about the georeference (such as scale, coordinate system, projection, etc) in the marginal information. Making the SIM understandable involves using conven-

tional cartographic symbols for features that are not easily or not at all visible on the images, such as the hydrographic systems, road networks, administrative boundaries and toponomy.

SIMs versus conventional maps: similarities, differences and uses

SIMs and conventional maps have some important properties in common. Both are representations of spatial information that are scaled and geometrically correct(ed), and thus offer us a modelled version of geographical reality.

The main differences are that the actual information about the geographic reality in SIMs is less directly available. Getting the information requires quite some interpretation of the image by the user; in conventional maps the interpretation of the reality has largely been done by the map-maker. This person has, for a conventional map, made a selection of the items or objects from reality to be shown in the map. The image in a SIM offers all information contained in the image itself, but no pre-selection has been done. It can be said that SIMs show 'raw' information, whereas conventional maps show classified, symbolised and generalised information. The raw information in the SIM is also limited to information that is visible, whereas conventional maps include much non-visible thematic info (eg. placenames, administrative boundaries).

From the differences and similarities with conventional maps, the main uses of SIMs can be derived.

1. To give a detailed, ungeneralised view of the geographic reality, as an
 - a) alternative view to traditional topographic mapping (eg. a map series to be used 'next to' existing conventional topo map series, as is the case in Malaysia), or as a
 - b) specialist view for thematic mapping (eg. false colour image maps, that better suit the needs of forestry specialists than conventional maps);
2. To substitute for where no (up to date) maps exist, as a
 - a) fast & cheap alternative to traditional topographic mapping, or for
 - b) mapping remote areas, where traditional topographic mapping is 'overkill' (it might be financially possible to make conventional maps, but it's not economical);
3. As a basis for topographic map revision.

The practice: Inventory of topographic SIMs worldwide

To get an idea of what use is being made of the theoretical possibilities sketched in the previous paragraphs, we decide to make an inventory of SIMs in the world today. In order to make this project feasible, it was decided to narrow down the inventory to the official, published, topographical SIMs. Therefore only maps or map series officially published by commercial publishers or governmental agencies were considered. Thus, pilots, research efforts, tests, calendars, seminar posters, etc., were not taken into account, even though we know of many examples of these things having SIM contents. Also no thematic SIMs (eg. the specialist maps for forestry mentioned before), application-specific SIMs, artistic outputs holding satellite information, 'coffee-table books' with satellite imagery, etc. were discounted.

The methodology used to get this inventory together was by starting off with the tremendous amount of information contained in "World Mapping Today" (2nd ed – 2000, by R.B. Parry & C.R. Perkins. London: Bowker Saur). This state of affairs for 2000 was then partly updated by Web search of known publishers and government agencies involved in SIMs. It has to be stressed that this is an ongoing effort, relying on participation of mapping agencies, publishers, etc. We have published the information on a dedicated website (<http://kartoweb.itc.nl/sim>) that offers an overview of the

current inventory and invites all parties involved to update it through this site. Hopefully we will thus create an up-to-date overview of SIM mapping in the world.

Results

Looking at an overview of topographic SIMs in all scales (see figure 1), some common denominators can be found. First of all, topographic SIMs are not common at all: only 51 countries have some form of topo SIM, on a total of 250 countries identified this is not much. Secondly, only 94 separate products (single maps or series) have been identified. In these products we find a wide variety. The scale of the SIMs found ranges from 1:10.000 until 1:10.325.000. Many of the products (61 out of the 94) are 1 sheet overview maps, 'poster-like' in appearance and often meant to be just that. There are relatively few large scale map series. It appears both governments agencies and commercial publishers are active in producing SIMs, and we see in both types some 'big players', such as the commercial publisher Map Appeal Inc. or the UK Ordnance Survey International (OSI).

If we take the image sources into consideration, it is interesting to note that virtually all are based on Landsat (by far the most) or SPOT imagery. This is partially explained from the publication dates of the products (no other possibilities were present), but also in more recent years, when newer data sources such as IKONOS were available, almost none of these have been used. All images are simple single images or mosaics, image fusion products have not been encountered. Many are simple colour composites, although more elaborate image enhancement techniques are found, especially to produce simulated natural colours.

The cartographic enhancements found fill the full range from almost none to full overlay of conventional topographic maps. Here we find a clear relation with scale: larger scales have more enhancements.

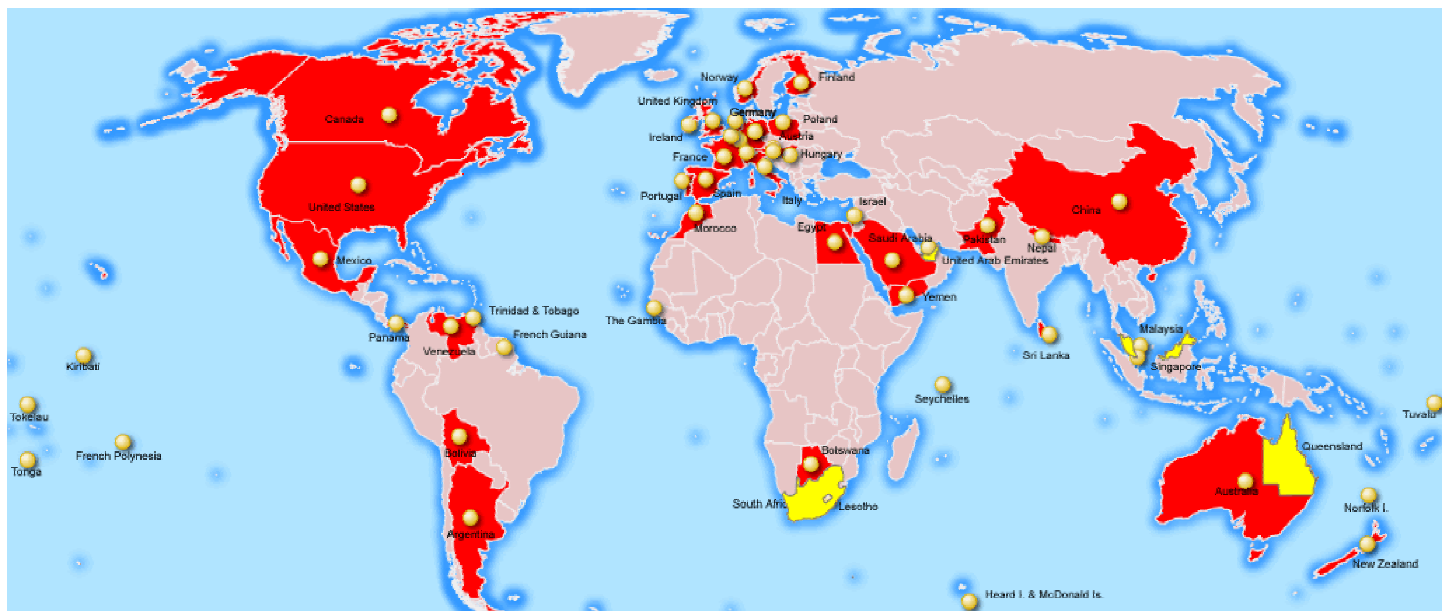


Figure 1: Overview of countries with topographic SIMs (all scales, yellow means a digital product or data is available)

Only 4 products are known to be available as digital products (where the final map can be ordered in digital form) or as digital data (where also the base data used to produce the SIM is made available).

Of the small scale maps (1:550.000 and smaller), the majority are of the before-mentioned 'poster' variety and serve as overview maps of (large parts of) countries. Examples are the 1:5 million "Image map of Canada / Carte image du Canada", published by NRCan in 1993, and the 1:4 million "Carta de ordenamiento del Mexico" by SAHOP (1981). A small number of maps in this scale range are more topographic maps proper, but at very small scales because of the remoteness and 'emptiness' of the areas mapped. One such example is the 1:2 million "Kingdom of Saudi Arabia" SIM.

In the middle scales (1:500.000 – 1:100.000, see figure 2) we also find overview maps, this time of small and medium-sized countries, such as the 1:275 000 "Satellietbeeldkaart Nederland", published by Malmberg in the Netherlands in 1982. Furthermore, there are middle scale topographic maps, mainly in larger series, such as the 1:250 000 "Arab Republic of Egypt: satellite image map", with 80 sheets published by TFH of Berlin from 1984 onwards, or the 1:100 000 "Ortoimagen espacial" of Spain (177 sheets from 1990 onwards, by IGNE of Madrid).

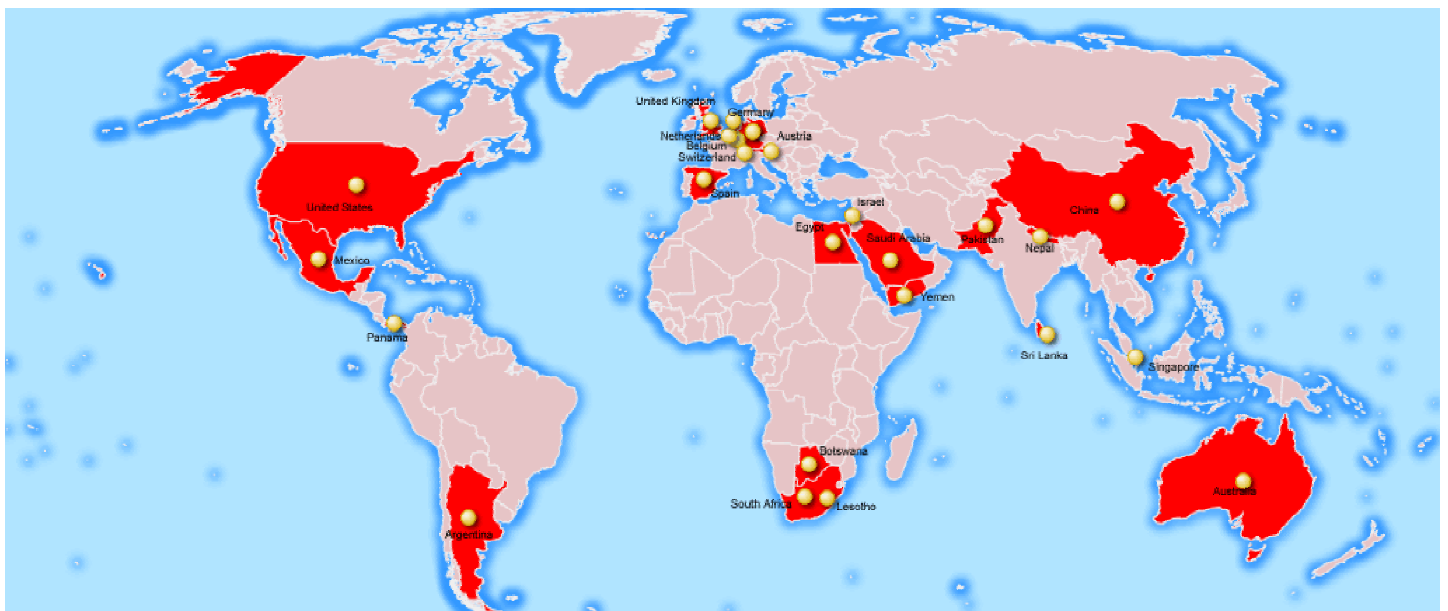


Figure 2: Overview of countries with middle scale topographic SIMs (1:500.000 – 1:100.000)

Looking at the large scale SIMS (1:50.000 and larger, figure 3), there are only a few series or products (18 in total) available. Here the categories of use, mentioned in the theoretical overview, can be clearly distinguished. 7 products are clearly identifiable as fast and cheap alternative to traditional topographic mapping. These are mainly found in the small island states, such as Cosos Island, French Polynesia and others. It is a clear trend here that these maps are being produced by the mapping agencies of the former colonising countries (eg. the UK's Ordnance Survey International) or from a neighbouring big country (eg. Australia's AUSLIG). 3 products have been found which can be thought of as a means of economically mapping remote areas, these are the map series for The Gambia (1:50 000 and 1:25 000) and the United Arab Emirates (1: 25 000). The others in this scale range are SIM series existing next to published and up-to-date conventional topographic map series and as such are alternative view to existing maps. This is where the Malaysian SIM should be categorised, together with similar efforts from Austria, Argentina, Italy, Germany's Rheinland-Westfalen state and Australia's Queensland.



Figure 3: Overview of countries with large scale topographic SIMs (1:50.000 and larger)

Conclusion

The conclusions from the inventory of theoretical possibilities and practical products is that SIMs, especially topographic SIMs, are still rather rare. We've seen that the most common type of SIM the 'country poster' variety SIMs as large scale topo series, either replacing them or as alternatives to them, are even more rare. As these last SIMs can in our opinion be considered as the only really serious application of the technology, we can safely say that the potential of SIM technology is at this moment not fully exploited. This becomes even more true if one compares the theoretical possibilities in image enhancement, image fusion and cartographic enhancements, with the use that is actually being made of these techniques in practice. One might expect that current events, such as the availability of data from new sensors offering high quality, large scale imagery, will open new possibilities, but it remains to be seen if these will be applied in every day Satellite Image Mapping. Considering all this, we can surely conclude that the Malaysian MACRES SIMs are in the forefront of the application of this technology.

APPENDIX 1:

topographic SIMs per country

Inventory of topographic SIMs: Official, published, topographical SIMs

Based on R.B. Parry & C.R. Perkins (2000): World Mapping Today (2nd ed). London: Bowker Saur

Partly updated by Web search, published & updated through <http://kartoweb.itc.nl/sim>

Note: only countries with some kind of topo SIM are shown

ISO	CNTRY_NAME	SIM	SIM 25k	SIM 50k	SIM 100k	SIM 250k	SIM 500k	SIM large	digital
ARE	United Arab Emirates	✓	✓						
ARG	Argentina	✓		✓	✓	✓			
AUS	Australia	✓	✓		✓				✓
AUT	Austria	✓		✓		✓	✓		
BEL	Belgium	✓					✓		
BOL	Bolivia	✓						✓	
BWA	Botswana	✓			✓				
CAN	Canada	✓						✓	
CCK	Cocos Is.	✓						✓	
CHE	Switzerland	✓					✓		
CHN	China	✓					✓	✓	
DEU	Germany	✓	✓	✓		✓			
EGY	Egypt	✓				✓			
ESP	Spain	✓			✓		✓	✓	
FIN	Finland	✓						✓	
FRA	France	✓						✓	
GBR	United Kingdom	✓					✓	✓	
GMB	The Gambia	✓	✓	✓					
GUF	French Guiana	✓						✓	
HMD	Heard I. & McDonald Is.	✓		✓					
HUN	Hungary	✓						✓	
IRL	Ireland	✓						✓	
ISR	Israel	✓					✓	✓	
ITA	Italy	✓		✓					
KIR	Kiribati	✓	✓						
LKA	Sri Lanka	✓					✓		
LSO	Lesotho	✓				✓			
LTU	Lithuania								
LUX	Luxembourg	✓			✓				
MAR	Morocco	✓						✓	
MEX	Mexico	✓					✓	✓	
MYS	Malaysia	✓		✓					✓
NFK	Norfolk I.	✓	✓						
NLD	Netherlands	✓					✓		
NOR	Norway	✓						✓	

ISO	CNTRY_NAME	SIM	SIM 25k	SIM 50k	SIM 100k	SIM 250k	SIM 500k	SIM large	digital
NPL	Nepal	✓					✓		
NZL	New Zealand	✓						✓	
PAK	Pakistan	✓					✓	✓	
PAN	Panama	✓				✓			
POL	Poland	✓						✓	
PRT	Portugal	✓						✓	
PYF	French Polynesia	✓	✓						
SAU	Saudi Arabia	✓				✓	✓	✓	
SGP	Singapore	✓			✓				
SYC	Seychelles	✓	✓						
TKL	Tokelau	✓	✓						
TON	Tonga	✓							
TUV	Tuvalu	✓	✓						
USA	United States	✓					✓	✓	
VEN	Venezuela	✓						✓	
YEM	Yemen	✓					✓		
ZAF	South Africa	✓				✓			✓

APPENDIX 2:

Topo SIM products identified

ISO	ARE		
Scale	25 000		
ID	45		
Title	-		
Pub_place	United Kingdom		
Publisher	NRSC Ltd.		
Pub_Date			
Num_sheets	31	Num_published	31
Digital_product	Digital_data		
Notes	Coverage of Dubai only; from SIMs 7 thematic layers where compiled: geology, geomorphology, soils, hydrology, land use, erosion and vegetation. Data held in Arc/Info, basis for environmental planning		
ISO	ARG		
Scale	50 000		
ID	1		
Title	Carta de imagen satelitaria de la Republica Argentina		
Pub_place	Buenes Aires		
Publisher	IGMA		
Pub_Date	1994-		
Num_sheets	160	Num_published	160
Digital_product	Digital_data		
Notes			
ISO	ARG		
Scale	100 000		
ID	2		
Title	Carta de imagen satelitaria de la Republica Argentina		
Pub_place	Buenes Aires		
Publisher	IGMA		
Pub_Date	1992-		
Num_sheets	215	Num_published	215
Digital_product	Digital_data		
Notes			
ISO	AUS		
Scale	50 000		
ID	3		
Title	Queensland		
Pub_place	Brisbane		
Publisher	QDNR		
Pub_Date			
Num_sheets	500	Num_published	500
Digital_product	Digital_data		
Notes	For/of Queensland State		

ISO	AUS
Scale	100 000
ID	4
Title	Australian Capital territory satellite image map
Pub_place	Belconnen
Publisher	AUSLIG
Pub_Date	1991
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	For/of Australian Capital territory
ISO	AUT
Scale	50 000
ID	55
Title	Satellitenbildkarte Österreich
Pub_place	Bad Ischl
Publisher	Geospace
Pub_Date	1990-
Num_sheets	213
Num_published	12
Digital_product	Digital_data
Notes	
ISO	AUT
Scale	500 000
ID	53
Title	Satellitenbildkarte Österreich
Pub_place	Bad Ischl
Publisher	Geospace
Pub_Date	1990
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	
ISO	AUT
Scale	2 000 000
ID	54
Title	Satellitenbildkarte Österreich
Pub_place	Bad Ischl
Publisher	Geospace
Pub_Date	1990-
Num_sheets	23
Num_published	5
Digital_product	Digital_data
Notes	
ISO	BEL
Scale	300 000
ID	56
Title	La Belgique vue de l'espace / Belgie vanuit de ruimte
Pub_place	Bruxelles
Publisher	IGNB
Pub_Date	1991
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	ccolour composite image map classified from LANDSAT scenes of 1989 and 1990

ISO BOL
 Scale 2 000 000
 ID 5
 Title Fotomosaico LANDSAT de Bolivia
 Pub_place La Paz
 Publisher SERGEOMIN
 Pub_Date 1980
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO BWA
 Scale 100 000
 ID 6
 Title Botswana
 Pub_place gabarone
 Publisher DSM
 Pub_Date 1981-
 Num_sheets 37 Num_published 37
 Digital_product Digital_data
 Notes

ISO CAN
 Scale
 ID 11
 Title Prince Edward Island Landsat poster
 Pub_place Halifax
 Publisher Nimbus
 Pub_Date 1996
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO CAN
 Scale 2 000 000
 ID 10
 Title Ontario
 Pub_place Ottawa
 Publisher NRCan
 Pub_Date 1993
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO CAN
 Scale 2 300 000
 ID 9
 Title British Columbia satellite map
 Pub_place Burlington
 Publisher Map Appeal Inc.
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO	CAN		
Scale	3 000 000		
ID	12		
Title	Image de Quebec par satellite		
Pub_place	Quebec		
Publisher	MRN		
Pub_Date			
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	unedited colour mosaic		
ISO	CAN		
Scale	5 000 000		
ID	8		
Title	Image map of Canada / Carte image du Canada		
Pub_place	Ottawa		
Publisher	NRCan		
Pub_Date	1993		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes			
ISO	CAN		
Scale	10 325 000		
ID	7		
Title	Canada		
Pub_place	Burlington		
Publisher	Map Appeal inc.		
Pub_Date	1993		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	simulated true colour image		
ISO	CCK		
Scale			
ID	87		
Title	Cocos Island satellite image map		
Pub_place	Belconnen		
Publisher	AUSLIG		
Pub_Date	1991		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	SPOT image base		
ISO	CHE		
Scale	300 000		
ID	86		
Title	Schweiz / Suisse / Svizzera		
Pub_place	Wabern		
Publisher	BLT		
Pub_Date	1998		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	simulated true colour satellite image base		

ISO CHE
 Scale 350 000
 ID 85
 Title Schweiz / Suisse / Svizzera / Svizra
 Pub_place Luzern
 Publisher Topmap
 Pub_Date 1997
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO CHE
 Scale 350 000
 ID 84
 Title Schweiz / Suisse / Svizzera / Svizra
 Pub_place Bad Ischl
 Publisher Geospace
 Pub_Date 1998
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes simulated true colour satellite image base

ISO CHE
 Scale 500 000
 ID 83
 Title Schweiz
 Pub_place Farnborough
 Publisher NRSC
 Pub_Date 1994
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes simulated true colour satellite image base

ISO CHN
 Scale 500 000
 ID 17
 Title LANDSAT image map of China
 Pub_place Beijing
 Publisher Science Press
 Pub_Date 1993
 Num_sheets 15 Num_published 15
 Digital_product Digital_data
 Notes English & Chinese

ISO CHN
 Scale 2 500 000
 ID 16
 Title LANDSAT image map of China
 Pub_place Beijing
 Publisher Science Press
 Pub_Date 1993
 Num_sheets 6 Num_published 6
 Digital_product Digital_data
 Notes English & Chinese

ISO	CHN
Scale	4 000 000
ID	15
Title	LANDSAT image map of China
Pub_place	Beijing
Publisher	Science Press
Pub_Date	1993
Num_sheets	2
Num_published	2
Digital_product	Digital_data
Notes	English & Chinese
ISO	CHN
Scale	6 000 000
ID	13
Title	NOAA AVHRR satellite photomap of China
Pub_place	Beijing
Publisher	Science Press
Pub_Date	1993
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	English & Chinese
ISO	CHN
Scale	6 000 000
ID	14
Title	LANDSAT imagemap of China
Pub_place	Beijing
Publisher	Science Press
Pub_Date	1993
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	English & Chinese
ISO	DEU
Scale	25 000
ID	64
Title	Luftbildkarte TK 25 L
Pub_place	Bonn
Publisher	LVANR-W
Pub_Date	1982-1992
Num_sheets	270
Num_published	270
Digital_product	Digital_data
Notes	For Bundesland Nordrhein-Westfalen
ISO	DEU
Scale	50 000
ID	62
Title	Satellitbildkarte von Hamburg und Umgebung
Pub_place	Hamburg
Publisher	AGVH
Pub_Date	
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	For Bundesland Hamburg; simulated natural colour

ISO	DEU		
Scale	50 000		
ID	61		
Title	Luftbildkarte von Berlin		
Pub_place	Berlin		
Publisher	SfBWV		
Pub_Date	1995		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	For Stadt Berlin only		
ISO	DEU		
Scale	100 000		
ID	63		
Title	Satellitbildkarte von Hamburg und Umgebung		
Pub_place	Hamburg		
Publisher	AGVH		
Pub_Date			
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	For Bundesland Hamburg; simulated natural colour		
ISO	DEU		
Scale	250 000		
ID	65		
Title	Satellitbildkarte Rheinland Pfalz und Saarland		
Pub_place	Koblenz		
Publisher	LVAR-P		
Pub_Date	1994		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	For Bundesland Rheinland-Pfalz; simulated true colour LANDSAT image map; available with and without place names and boundaries overprint		
ISO	EGY		
Scale	250 000		
ID	18		
Title	Arab Republic of Egypt: satellite image map		
Pub_place	Berlin		
Publisher	TFH		
Pub_Date	1984-		
Num_sheets	80	Num_published	80
Digital_product	Digital_data		
Notes			
ISO	ESP		
Scale	100 000		
ID	82		
Title	Ortoimagen espacial		
Pub_place	Madrid		
Publisher	IGNE		
Pub_Date	1990-		
Num_sheets	177	Num_published	177
Digital_product	Digital_data		
Notes	natural colour image maps		

ISO ESP
 Scale 500 000
 ID 81
 Title Ortoimagen espacial
 Pub_place Madrid
 Publisher IGNE
 Pub_Date 1995-
 Num_sheets 12 Num_published 12
 Digital_product Digital_data
 Notes natural colour image maps

ISO ESP
 Scale 2 000 000
 ID 80
 Title Peninsula Iberica, Baleares y Canarias: mosaico LANDSAT
 Pub_place Madrid
 Publisher IGNE
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes single colour LANDSAT band 7 image

ISO FIN
 Scale 1 000 000
 ID 58
 Title Suomi satelliittikuva / Finland fran satellit
 Pub_place Helsinki
 Publisher NLS
 Pub_Date 1980
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO FRA
 Scale 1 000 000
 ID 59
 Title La France vue par satellite
 Pub_place Orléans
 Publisher BRGM & BEICIP
 Pub_Date 1974
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO GBR
 Scale
 ID 66
 Title British Isles: false colour
 Pub_place Bristol
 Publisher Earth Images
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO GBR
 Scale
 ID 67
 Title British Isles: natural colour
 Pub_place Bristol
 Publisher Earth Images
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO GBR
 Scale 350 000
 ID 71
 Title Scotland
 Pub_place Bristol
 Publisher Earth Images
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO GBR
 Scale 350 000
 ID 69
 Title Wales from space
 Pub_place Keyworth
 Publisher BGS
 Pub_Date 1995
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO GBR
 Scale 1 000 000
 ID 70
 Title Scotland: a portrait from space
 Pub_place Farnborough
 Publisher NRSC
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO GBR
 Scale 1 650 000
 ID 68
 Title United Kingdom and the Republic of Ireland from space
 Pub_place Farnborough
 Publisher NRSC
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO GMB
 Scale 25 000
 ID 44
 Title The Gambia
 Pub_place Banjul
 Publisher GDLS
 Pub_Date 1983
 Num_sheets 84 Num_published 84
 Digital_product Digital_data
 Notes

ISO GMB
 Scale 50 000
 ID 43
 Title The Gambia
 Pub_place Banjul & Southhampton
 Publisher GDLS & OSI
 Pub_Date 1975-1981
 Num_sheets 20 Num_published 20
 Digital_product Digital_data
 Notes

ISO GUF
 Scale
 ID 19
 Title French Guiana through the clouds / La Gyane à travers les
 Pub_place Paris
 Publisher TELECOM
 Pub_Date 1992
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes mosaic of ERS-1 images

ISO HMD
 Scale 50 000
 ID 88
 Title Australian external territory of Heard and MacDonal Isalnds
 Pub_place Belconnen
 Publisher AUSLIG
 Pub_Date 1991
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes includes inset covering Macdonald Islands at 1:25.000

ISO HUN
 Scale 550 000
 ID 72
 Title Magyarorszag ürfelvételeken / Hungary from space
 Pub_place Budapest
 Publisher FöMI & Cartographia
 Pub_Date 1988
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO	IRL		
Scale			
ID	57		
Title	Satellite touring map of Ireland		
Pub_place	Dublin		
Publisher	ERA-Maptec		
Pub_Date	1988		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes			
ISO	ISR		
Scale	500 000		
ID	21		
Title	Satellite photomap of Israel		
Pub_place	Tel Aviv		
Publisher	SI		
Pub_Date	1988		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	Hebrew language		
ISO	ISR		
Scale	500 000		
ID	22		
Title	SPOT view of Israel		
Pub_place	Tel Aviv		
Publisher	SI		
Pub_Date	1994		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes	simulated natural colour, no place names		
ISO	ISR		
Scale	750 000		
ID	20		
Title	Satellite photomap of Israel		
Pub_place	Tel Aviv		
Publisher	SI		
Pub_Date	1974		
Num_sheets	1	Num_published	1
Digital_product	Digital_data		
Notes			
ISO	ITA		
Scale	50 000		
ID	73		
Title	Spaziocarta Series 50/S		
Pub_place	Firenze		
Publisher	IGMI		
Pub_Date	1986-		
Num_sheets	636	Num_published	186
Digital_product	Digital_data		
Notes			

PUBLISHED IN:
 PROCEEDINGS OF THE NATIONAL SEMINAR ON SATELLITE IMAGE MAP (SIM) PRODUCTION AND OPERATIONALISATION.
 KUALA LUMPUR (MALAYSIA): MALAYSIAN CENTRE FOR REMOTE SENSING (MACRES), PP. 1-27

ISO KIR
 Scale 25 000
 ID 91
 Title Kiribati, series X042
 Pub_place Southampton & Bairiki
 Publisher OSI & KLSd
 Pub_Date 1977-
 Num_sheets 29 Num_published 29
 Digital_product Digital_data
 Notes Kirimati & Tarawa at 1:50.000, Marakei at 1:12.500, rest at 1:10.000

ISO LKA
 Scale 500 000
 ID 42
 Title Sri lanka: satellite image mosaic
 Pub_place Colombo
 Publisher SLSD
 Pub_Date 1994
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO LSO
 Scale 250 000
 ID 23
 Title Satellite image map of Lesotho
 Pub_place Maseru
 Publisher LSPP
 Pub_Date 1989
 Num_sheets 2 Num_published 2
 Digital_product Digital_data
 Notes

ISO LUX
 Scale 100 000
 ID 74
 Title Grand-Duché de Luxembourg: image satellitaire
 Pub_place Luxembourg
 Publisher MEV
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO MAR
 Scale 1 000 000
 ID 29
 Title Maroc vue de satellite
 Pub_place Rabat
 Publisher SGM
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes 5 versions with different themes overprinted

ISO	MEX
Scale	
ID	27
Title	Carta de ordenamiento del territorio del estado
Pub_place	Mexico
Publisher	SAHOP
Pub_Date	1981
Num_sheets	31
Num_published	31
Digital_product	Digital_data
Notes	Provincial maps, various scales
ISO	MEX
Scale	1 000 000
ID	28
Title	Estados Unidos Mexicanos: fotomapa
Pub_place	Aguascalientes
Publisher	INEGI
Pub_Date	1980
Num_sheets	8
Num_published	8
Digital_product	Digital_data
Notes	LANDSAT image base
ISO	MEX
Scale	4 000 000
ID	26
Title	Carta de ordenamiento del Mexico
Pub_place	Mexico
Publisher	SAHOP
Pub_Date	1981
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	
ISO	MEX
Scale	4 250 000
ID	25
Title	Mexico desde el espacio: una nueva vision del pais
Pub_place	Oakville
Publisher	Map Appeal Inc.
Pub_Date	1993
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	simulated natural colours
ISO	MYS
Scale	50 000
ID	24
Title	Satellite Image Map of Malaysia
Pub_place	Kuala Lumpur
Publisher	MACRES
Pub_Date	?-2005
Num_sheets	
Num_published	36
Digital_product	Digital_data
Notes	Completed 19 for state of Selangor and 37 for State of Pahang, planning for whole Peninsular Malaysia by Year 2005 . SIM maps will be available digitally.

ISO NFK
 Scale 15 000
 ID 92
 Title Norfolk Island
 Pub_place Belconnen
 Publisher AUSLIG
 Pub_Date 1992
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO NLD
 Scale 275 000
 ID 75
 Title Satellietbeeldkaart Nederland
 Pub_place Den Bosch
 Publisher Malmberg
 Pub_Date 1982
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO NOR
 Scale 2 000 000
 ID 76
 Title Norge fra satellit
 Pub_place Oslo
 Publisher FW
 Pub_Date 1983
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO NPL
 Scale 500 000
 ID 30
 Title Nepal
 Pub_place Tolworth
 Publisher DOS
 Pub_Date 1982
 Num_sheets 2 Num_published 2
 Digital_product Digital_data
 Notes

ISO NZL
 Scale 1 000 000
 ID 33
 Title LANDSAT New Zealand 1:1.000.000 info map 296
 Pub_place Wellington
 Publisher LINZ
 Pub_Date 1979
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO NZL
 Scale 2 000 000
 ID 31
 Title New Zealand from space
 Pub_place Burlington
 Publisher Map Appeal Inc.
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes simulated natural colour

ISO NZL
 Scale 2 000 000
 ID 32
 Title New Zealand from LANDSAT
 Pub_place Wellington
 Publisher LINZ
 Pub_Date 1978
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO PAK
 Scale 500 000
 ID 35
 Title Pakistan satellite image map
 Pub_place Reston, VA
 Publisher USGS
 Pub_Date 1997
 Num_sheets 7 Num_published 7
 Digital_product Digital_data
 Notes

ISO PAK
 Scale 2 000 000
 ID 34
 Title Pakistan satellite image map
 Pub_place Reston, VA
 Publisher USGS
 Pub_Date 1997
 Num_sheets Num_published
 Digital_product Digital_data
 Notes

ISO PAN
 Scale 250 000
 ID 36
 Title Panama edicion LANDSAT
 Pub_place Panama
 Publisher IGNTG
 Pub_Date 1996-
 Num_sheets 12 Num_published 2
 Digital_product Digital_data
 Notes

ISO POL
 Scale 750 000
 ID 77
 Title Polska Mapa satelitarna / Poland satellite image map
 Pub_place Warszawa
 Publisher IGIK
 Pub_Date 1992
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO PRT
 Scale 600 000
 ID 79
 Title Portugal vista do espacio
 Pub_place Lisboa
 Publisher IHERA
 Pub_Date 1987
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes false colour poster map for CORINE project

ISO PRT
 Scale 600 000
 ID 78
 Title Carta imagem de Portugal continental
 Pub_place Lisboa
 Publisher IPCC
 Pub_Date 1998
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes LANDSAT four colour composite image map

ISO PYF
 Scale 20 000
 ID 90
 Title Spatiocartes
 Pub_place Papeete
 Publisher SU
 Pub_Date 1985-
 Num_sheets 3 Num_published 3
 Digital_product Digital_data
 Notes various scales

ISO SAU
 Scale 250 000
 ID 39
 Title Kingdom of Saudi Arabia: geographic map
 Pub_place Jiddah
 Publisher DMMR
 Pub_Date 1973-1984
 Num_sheets 110 Num_published 59
 Digital_product Digital_data
 Notes image base with topographic overprint

ISO SAU
 Scale 500 000
 ID 38
 Title Kingdom of Saudi Arabia
 Pub_place Jiddah
 Publisher Farsi
 Pub_Date
 Num_sheets 4 Num_published 4
 Digital_product Digital_data
 Notes enlarged version of 1: 2 mln map

ISO SAU
 Scale 2 000 000
 ID 37
 Title Kingdom of Saudi Arabia
 Pub_place Jiddah
 Publisher Farsi
 Pub_Date
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO SGP
 Scale 100 000
 ID 40
 Title Singapore: satellite image from 870 km
 Pub_place Dublin
 Publisher ERA Maptech
 Pub_Date 1987
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes simulated true colour image

ISO SYC
 Scale 25 000
 ID 89
 Title Republic of Seychelles DOS 104P, 204P, 304P
 Pub_place Victoria & Southampton
 Publisher LID & OSI
 Pub_Date 1978-1993
 Num_sheets 22 Num_published 22
 Digital_product Digital_data
 Notes some sheets at 1:10.000 & 1:12.500

ISO TKL
 Scale 25 000
 ID 93
 Title Tokelau Infomap 272
 Pub_place Wellington
 Publisher LINZ
 Pub_Date 1982-1984
 Num_sheets 3 Num_published 3
 Digital_product Digital_data
 Notes

ISO	TON
Scale	50 000
ID	94
Title	Tongatapu series X773
Pub_place	Nuku'alofa & Southampton
Publisher	TMLSNR & OSI
Pub_Date	1971
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	
ISO	TUV
Scale	
ID	95
Title	Tuvalu series X041
Pub_place	Southampton & Vaiaku
Publisher	OSI & TDLS
Pub_Date	1975-1980
Num_sheets	6
Num_published	6
Digital_product	Digital_data
Notes	Vaitupu 1:10.000, Funafuti 1:50.000, rest 1:25.000
ISO	USA
Scale	
ID	52
Title	Satellite view of Tennessee
Pub_place	Murfreesboro
Publisher	Tennessee state university
Pub_Date	1986
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	
ISO	USA
Scale	500 000
ID	51
Title	Oregon LANDSAT mosaic
Pub_place	Corvallis
Publisher	ERSAI
Pub_Date	1982
Num_sheets	2
Num_published	2
Digital_product	Digital_data
Notes	
ISO	USA
Scale	500 000
ID	48
Title	Satellite image map of Illinois
Pub_place	Champaign
Publisher	ISGS
Pub_Date	1986
Num_sheets	1
Num_published	1
Digital_product	Digital_data
Notes	colour map based on LANDSAT imagery

ISO USA
 Scale 1 000 000
 ID 49
 Title Satellite image map of Kentucky
 Pub_place Lexington
 Publisher KGS
 Pub_Date 1992
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes colour map based on LANDSAT 4 & 5 imagery

ISO USA
 Scale 5 000 000
 ID 50
 Title Satellite view of Nebraska
 Pub_place Lincoln
 Publisher CALMIT
 Pub_Date 1997
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO VEN
 Scale 3 000 000
 ID 47
 Title Mosaicos de imagenes de satelites LANDSAT 1 y 2 de Venezuela
 Pub_place Caracas
 Publisher CAIGEOMIN
 Pub_Date 1977
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO YEM
 Scale 500 000
 ID 46
 Title Geographic map of the Yemen Arab Republic
 Pub_place Reston, VA
 Publisher USGS
 Pub_Date 1978
 Num_sheets 1 Num_published 1
 Digital_product Digital_data
 Notes

ISO ZAF
 Scale 250 000
 ID 41
 Title Spacemaps
 Pub_place Pretoria
 Publisher SAC
 Pub_Date 1995-
 Num_sheets 70 Num_published 70
 Digital_product Digital_data
 Notes