

Satellite and GIS technologies

What can be done

Case Study from Baku, Peshawar, Karachi, Fiji, Micronesia

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Introduction to e-GEOS

Industrial structure, main assets and capabilities

Industrial structure



- **Contracts**
- **People**
- **Assets**

80%

e-geos
AN ASI / TELESPIAZIO COMPANY

20%



COSMO-SkyMed
exclusive world wide rights



Key figures

Geoinformation Business

>100M €

Revenues

>500

People



Telespazio Group Presence

| | | |
|--|--|---|
| | Telespazio A Finmeccanica/Thales Company | e-geos AN ASI / TELESPIAZIO COMPANY |
| | Telespazio VEGA Deutschland spaceopal | GAFAG AN ASI / TELESPIAZIO COMPANY |
| | Telespazio France | |
| | Telespazio VEGA United Kingdom | |
| | Telespazio Ibérica | |
| | Rartel Telespazio/Thales Company | |
| | Telespazio Hungary | |
| | Telespazio Brasil | |
| | Telespazio Argentina | |
| | Telespazio North America | |

Neustrelitz – GAF/DLR Station



Munich – GAF Headquarter



Roma Headquarter



Matera Space Center



Our premises



COSMO-SkyMed
COMMERCIAL OPERATOR

DATA PORT
SERVICES

SATELLITE DATA &
AERIAL SURVEY

MAPPING &
MONITORING

GEO-INFORMATION
SOLUTIONS

Our product portfolio

Satellites for Transport infrastructures applications

Practical examples in the context of ESA/ADB project

The User: Asian Development Bank



The Project: Implementation of Sustainable Transport in Asia and the Pacific - Better Transport Data for Sustainable Transport Policies and Investment Planning (Subproject 1) – 45105-005

The Problem: scarce availability and quality of transport data in the Asia and the Pacific region, preventing better informed policies and investment decisions in Developing Member Countries (DMCs). Detailed and updated knowledge about the spatial distribution of transportation assets is relevant also to DRR policies

Why satellite Earth Observation (EO)?

| Specific advantages of Earth Observation | |
|--|--|
| ADV01 – Cost effectiveness | ADV05 – Scalability to wider areas |
| ADV02 – Update frequency | ADV06 – Share /distribution of results |
| ADV03 – Comparability of results | ADV07 – Data continuity |
| ADV04 – Objectivity | ADV08 – Validation |

Earth Observation advantages

| ID | Advantage name | Advantage description |
|-------|---------------------------------------|--|
| ADV01 | Cost (€/sqkm) | Tangible (€/sqkm). It measures the unit cost compared to the unit cost to deliver equivalent products with alternative methods. It is expected that EO based products will be advantageous in this dimension thanks to the wide coverage allowed and the remote processing possibility. |
| ADV02 | Update frequency | Tangible (updates/year). It measures the update frequency compared to the update frequency to deliver equivalent products with alternative methods. It is expected that EO based products will be advantageous in this dimension thanks to the capability to acquire multiple coverages during the same calendar year |
| ADV03 | Comparability of results | Intangible. It indicates the easiness to compare results obtained in different regions compared to alternative methods It is expected that EO based products will be advantageous in this dimension thanks to the fact that the methodology is based on standard procedures and homogeneous input EO data |
| ADV04 | Objectivity | Intangible. It indicates the degree of objectivity of this method compared to alternative methods. It is expected that EO based products will be advantageous in this dimension thanks to the fact that the methodology is based on shared standards and unambiguous sources (satellite images) |
| ADV05 | Scalability to wider areas | Intangible. It indicates the easiness to scale this method to larger coverages (e.g. whole country) compared to alternative methods. It is expected that EO based products will be advantageous in this dimension thanks to the fact that suitable EO data can be acquired over large areas as, for example, a whole country. |
| ADV06 | Share /distribution of results | Intangible. It indicates the easiness to share and distribute the results generated by applying this method compared to alternative methods. It is expected that EO based products will be advantageous in this dimension thanks to the fact that output GIS layers can be easily shared through a wide number of low profile desktop and web applications. |
| ADV07 | Data continuity | Intangible. It indicates the foreseen capability to acquire data and generate results in the long terms by applying this method compared to alternative methods. It is expected that EO based products will be advantageous in this dimension thanks to the fact that suitable satellite mission have long term continuity plans. |
| ADV08 | Validation | Intangible. It indicates the possibility to validate output data generated by applying this method compared to alternative methods. It is expected that EO based products will be advantageous in this dimension thanks to the fact that output GIS layers can be easily validated by applying standard techniques and validation data . |

Product 1 – Transport infrastructure inventory and change



Short description

The Product is a detailed inventory (and their change over time) of all transport infrastructure that can be detected by the analysis of a satellite image.

Level of Detail

Depending on the resolution of the EO data sources used, up until small elements in the range of few meters size.

Recommended usage

Large area projects, at regional or national scale. Monitoring the effects of transport related policies and getting objective elements to define new priorities

Azerbaijan

SPOT-6/7

1.5 m

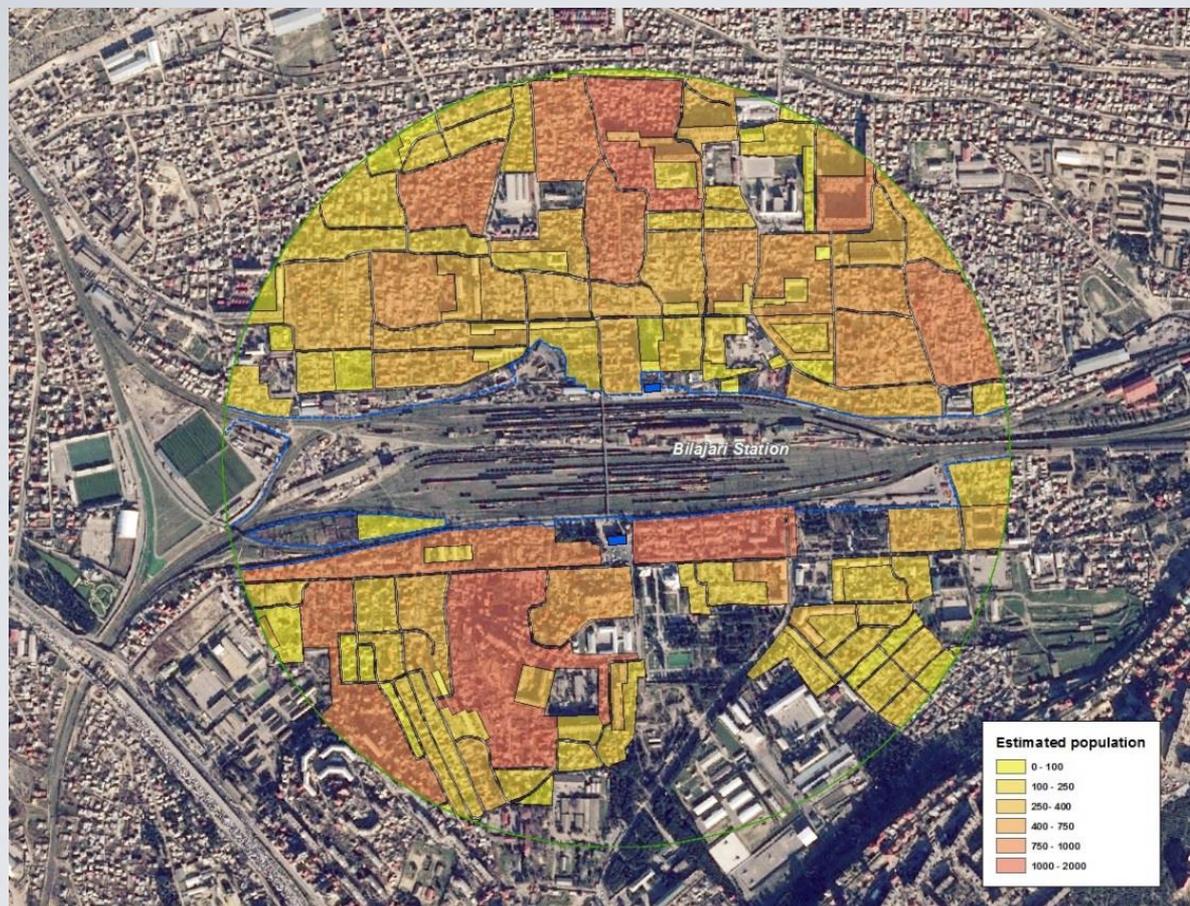
**2003
2014**

Change detection

Accuracy
 Minimum Mapping Length (MML): **300** meters
 Minimum Mapping Unit (MMU): **2,500** square meters.
 Relative geometric accuracy: **1 pixel** compared to the primary source image.



Product 2 – Population density



Short description

The Product is an estimation of population and population density within 1km radius from planned/existing stations based on the controlled disaggregation of national official census data. The product does not necessarily require in field surveys.

Level of Detail

Depending on the resolution of the EO data sources used, up to the single building.

Recommended usage

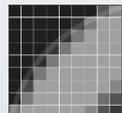
Transportation planning projects, assessment of potential demand, assessment of potential beneficiaries.



Azerbaijan



SPOT-6/7



1.5 m



2014

Accuracy

Population estimation: +/- 15%.

Product 4 – Maritime traffic statistics



Satellite Data Details

[IMAGE DATA]
 UTC Acquisition Date Time = "2010-11-30 15:54:26"
 Image Size = 16541, 16632
 Image Spacing = 2.5, 2.5
 Image Resolution = 5.0, 5.0
 Number of Detected Ship = 19

[INSPECTED AREA]
 MGS84 Top Left Corner Coordinates = 32.128, 31.667
 MGS84 Top Right Corner Coordinates = 32.193, 31.235
 MGS84 Bottom Left Corner Coordinates = 31.759, 31.589
 MGS84 Bottom Right Corner Coordinates = 31.824, 31.159

Single "Target" Details

[Vessel Data #1]
 MGS84 Geographical Coordinates = 32.084, 31.2073
 UTC Target Date Time = "2010-11-30 15:54:29"
 Eise Class = "A"
 Image Coordinates = 13248, 7300
 Target Direction = 290
 Target Velocity = 3.2
 Quality Factor = 387.212
 Low Value = 672.981
 AIS MMSI = 247104500
 Satellite AIS MMSI = "NOT AVAILABLE"
 LRIT MMSI = 247104500
 VMS Name = "NOT AVAILABLE"

ASCII format

[TARGET DATA #2]
 MGS84 Geographical Coordinates = 31.9722, 31.3069
 UTC Target Date Time = "2010-11-30 15:54:30"
 Image Coordinates = 12163, 9179
 Eise Class = "C"
 Target Direction = 147
 Target Velocity = 4.5
 Quality Factor = 38.9562
 Low Value = 367.283
 AIS MMSI = 247258900
 Satellite AIS MMSI = "NOT AVAILABLE"
 LRIT MMSI = 247258900
 VMS Name = "NOT AVAILABLE"

"Target" Size Classes:
 "A" for target size ≥ 100 m.
 "B" for target size 50 m + 100 m.
 "C" for target size 20 m + 50 m.
 "D" for target size ≤ 20 m.

Direction and Velocity
 They can be derived if the target wake is visible on the satellite data

Target Identification
 If identification data are available (ASI, LRIT, VMS, ...) the correlation processes allow to identify the target detected on the satellite image and, moreover, to individuate the not-correlated targets that need further direct analysis by the End User

KML format

ESRI format

Short description

The Product is a detailed land use generated over a 250m/500m buffer area along the actual/planned layout of a linear transport infrastructure.

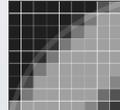
Level of Detail

Depending on the resolution of the EO data sources used, up until small boats in the range of few meters size can be detected.

Recommended usage

Gathering knowledge and statistics about the vessel traffic over the Area of Interest, including both cooperative and non cooperative vessels.

COSMO-SkyMed © ASI Processed by e-GEOS



Azerbaijan COSMO-SkyMed

30 m

2012

Accuracy

Relative geometric accuracy: **1 pixel** compared to the primary source image.

Support to visual interpretation and validation

| | |
|-------------------------------------|---|
| GeoNames | http://www.geonames.org |
| | Points of Interest and other point transport elements. |
| | |
| Openstreetmap | http://www.openstreetmap.org/# |
| | Point, line and polygon transport infrastructure elements. |
| | |
| Google Panoramio | http://www.panoramio.com/ |
| | In field pictures, collected and shared by users. |
| | |
| Google Street View | https://www.google.com/maps/views/u/0/streetview?gl=it&hl=it |
| | In field 360° picture, professionally collected |
| | |
| Vessel identification data | Coastal and satellite AIS data (historical) |
| EO data geometric processing | |
| SRTM90 | http://www.cgiar-csi.org/data/srtm-90m-digital-elevation-database-v4-1 |
| | Digital Elevation Model |
| | |
| Population estimation | |
| Azerbaijan National Statistics | www.stat.gov.az/indexen.php |
| | Official Azerbaijan Census data |
| GeoHive demographic data | http://www.geohive.com/ |
| | Other demographic data |

-  Product 1 – Transport inventory
-  Product 2 – Population estimation
-  Product 3 – Detailed land use

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-  Product 2 – Population estimation
-  Product 3 – Detailed land use

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-  Product 2 – Population estimation
-  Product 3 – Detailed land use

-  Product 1 – Transport inventory
-  Product 2 – Population estimation
-  Product 3 – Detailed land use

-  Product 4 – Maritime traffic statistics

-  Product 1 – Transport inventory
-  Product 2 – Population estimation
-  Product 3 – Detailed land use

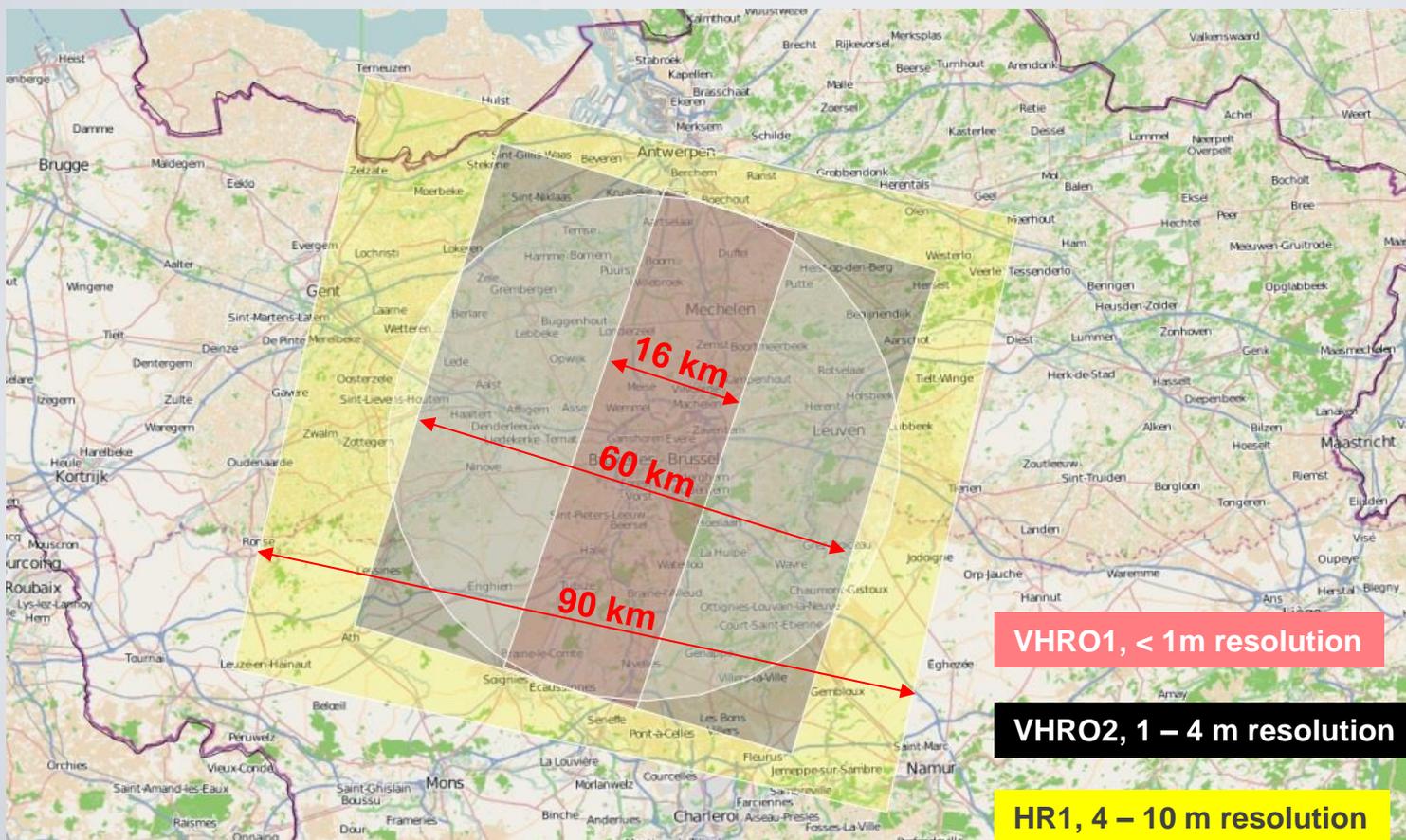
-  Product 2 – Population estimation

-  Product 2 – Population estimation

The Service – Satellite data sources

The Service is based on the analysis of Optical satellite images, acquired under:

- different **satellite platforms** (SPOT6&7, GeoEye-1, WorldView-2, WorldView-3, QuickBird, ...)
- different **ground resolution** (30 cm, 50cm, 1.5 m, 2.4 m)
- different **coverages** (the lower the resolution, the larger the coverage of a single scene)



Service Cost = Product Type x Level of Detail x Area of Interest



| | | |
|--|---|----------|
|  | Product 1 – Transport inventory | (\$) |
|  | Product 2 – Population estimation | (\$\$) |
|  | Product 3 – Detailed land use | (\$\$\$) |
|  | Product 4 – Maritime traffic statistics | (\$) |



- a) Size
- b) Complexity



- a) Cartographic scale
- b) Minimum Mapping Unit (MMU)
- c) Minimum Mapping length (MML)
- d) Number of objects/elements identified

Service 1 – Transport infrastructure inventory and change

- **Total length of network** (road, railroad, waterway);
- **% of network length responding to predefined technical characteristics** (e.g. width, pavement, lanes,...);
- **Airports/harbour capacity;**
- **Airports/harbour accessibility;**
- **Network connectivity** (Shortest Time Distance – STD, Weighted Average Travel Time - WATT)

Service 2 – Population density and detailed land use mapping

- **Total population estimated for each serviced station;**
- **Land use statistics.**

Service 3 – Maritime traffic statistics

- **Vessels statistics per size class and per month/day.**

The Service – Test Areas of Interest

Baku (Azerbaijan)



Product 1 – Transport inventory



Product 2 – Population estimation



Product 3 – Detailed land use



Product 4 – Maritime traffic statistics

Peshawar (Pakistan)



Product 1 – Transport inventory



Product 2 – Population estimation



Product 3 – Detailed land use

Karachi (Pakistan)



Product 2 – Population estimation



Product 3 – Detailed land use

Suva (Fiji)

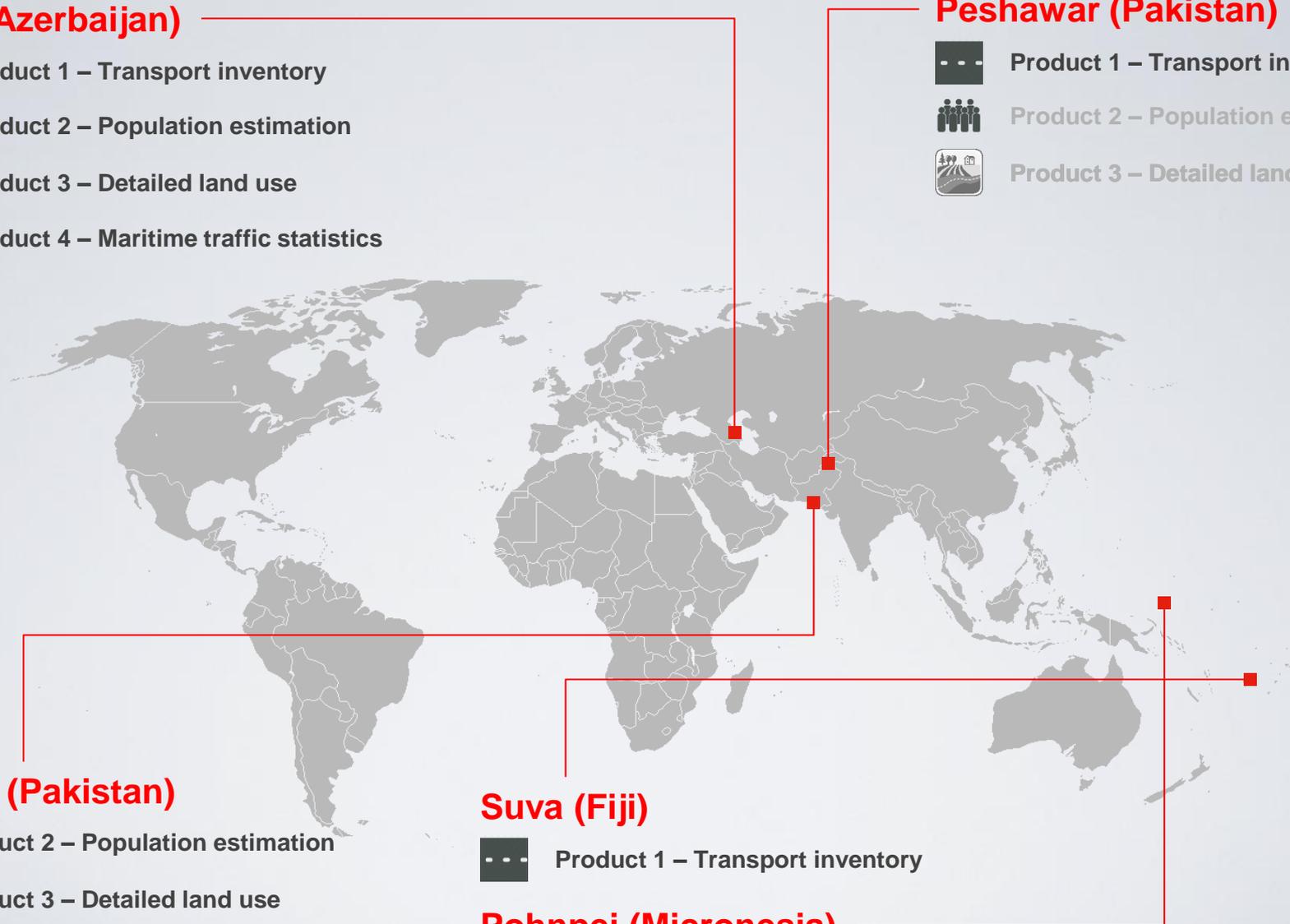


Product 1 – Transport inventory

Pohnpei (Micronesia)



Product 1 – Transport inventory



Case Study #1 – Peshawar (Pakistan)

Product 1 – Transport infrastructure inventory and change

Area of Interest: 976 km²

Satellite EO data sources:



SPOT-5



2.5 m



16/11/2012



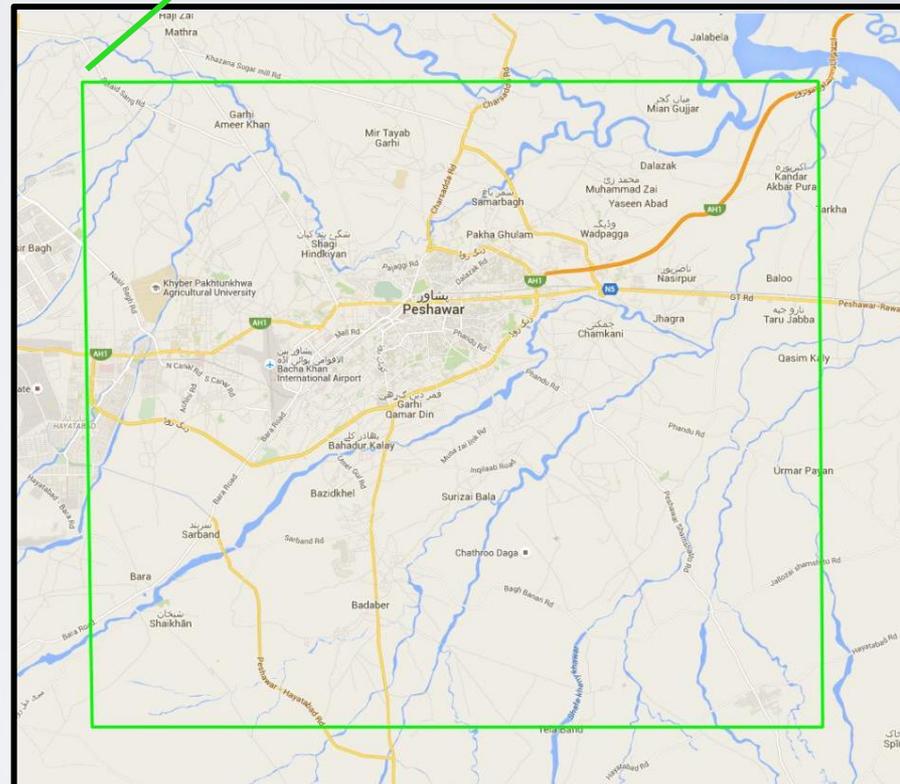
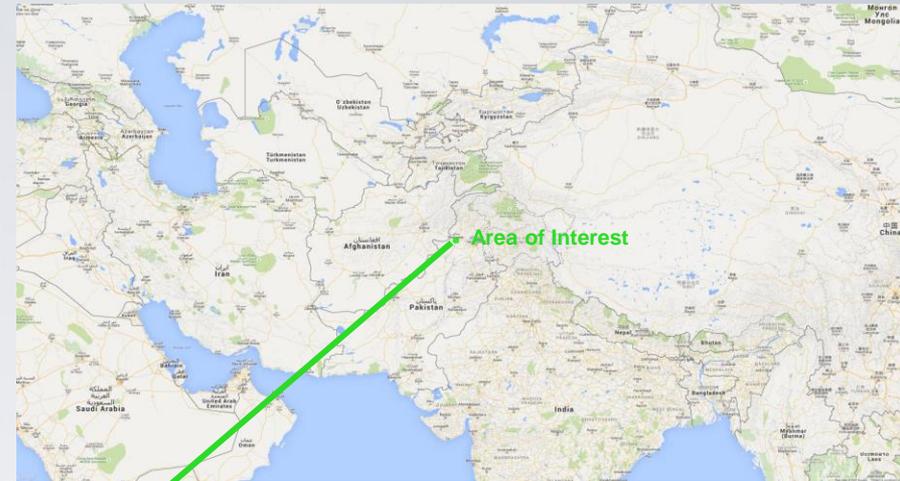
QuickBird



2.4 m



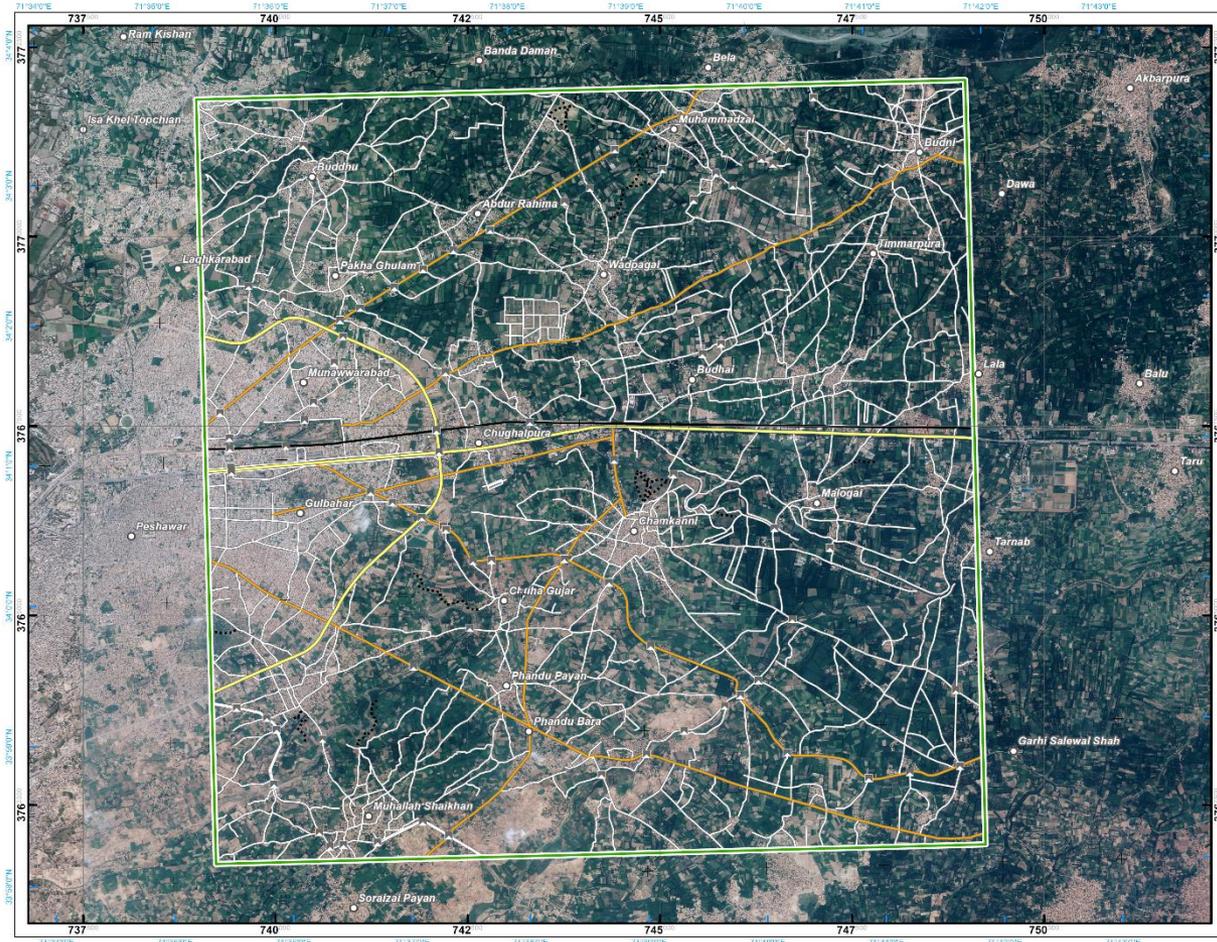
31/07/2005
06/10/2005



Case Study #1 – Peshawar (Pakistan)



Sample map products - Transport infrastructure inventory and change



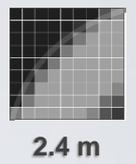
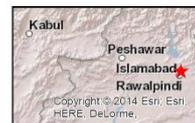
Coordinate System: WGS 1984 UTM Zone 42N
 Projection: Transverse Mercator
 Datum: WGS 1984
 False Easting: 500,000,000.0
 False Northing: 0.0000
 Central Meridian: 69.0000
 Scale Factor: 0.9996
 Latitude Of Origin: 0.0000
 Units: Meter
 Printed on: 27/07/2015

Peshawar - Pakistan
 Transport Infrastructure Map - 31/07/2015



1:50,000

1 cm = 500 m



EOTAP project:

Collecting Transport Infrastructure Intelligence in Asia and the Pacific

Contractor: e-GEOS (Italy).

Interpretation: The present map shows transportation features derived from public datasets, refined by means of visual interpretation of high resolution optical satellite images. All satellite images have been radiometrically enhanced and orthorectified with RPC approach. The estimated geometric accuracy of this product is 5 m CE90 or better, from native positional accuracy of the background satellite image. The estimated thematic accuracy of this product is 85% or better, (choose the most appropriate one) as it is based on visual interpretation of recognizable items on very high resolution optical imagery. Only the area enclosed by the Area of Interest has been analyzed. Map produced on by e-GEOS under contract 4000111723-14-1-AM with ESA. All products are © of the European Space Agency (ESA).

Image data: Quickbird © DigitalGlobe (acquired on 31/07/2005, GSD 2.4 m, approx. 0% cloud coverage, 24.88° off-nadir). All rights reserved.

Vector data: Base vector layers based on OpenStreetMap © OpenStreetMap contributors, Wikimapia.org, GeoNames (approx. 1:10,000, extracted on 01/01/2001), refined by e-GEOS. Source information is included in vector data.

Base map: Quickbird

- | | |
|------------------------------------|-----------------|
| Area of Interest | Road |
| Populated Place | Primary Route |
| Associated Transportation Features | Secondary Route |
| Bridge | Local Route |
| | Railway |

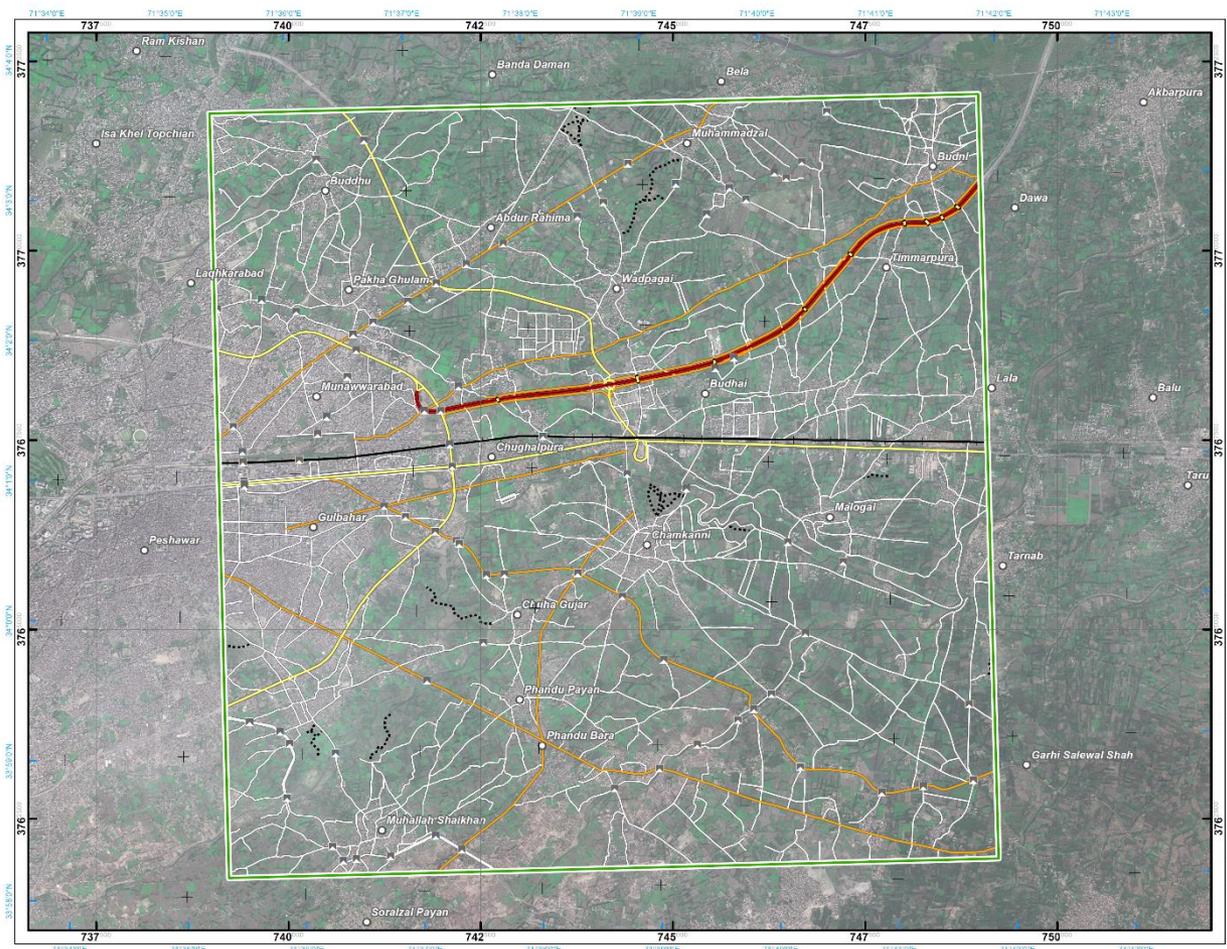
EOTAP is a set of twelve projects with the purpose to produce, deliver and assess the benefits of information services based on Earth Observation (EO), in support of ongoing Asian Development Bank (ADB) projects. This work is part of the European Space Agency's efforts to raise awareness within International Financial Institutions and Multilateral Development Banks of the capabilities of EO to provide information customised to the needs of individual bank projects, with emphasis on using data from European and Canadian EO satellite missions.



Case Study #1 – Peshawar (Pakistan)



Sample map products - Transport infrastructure inventory and change




EOTAP project:
Collecting Transport Infrastructure Intelligence in Asia and the Pacific
 Contractor: e-GEOS (Italy).

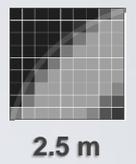
Interpretation: The present map shows transportation features derived from public datasets, refined by means of visual interpretation of high resolution optical satellite images. All satellite images have been radiometrically enhanced and orthorectified with RPC approach. The estimated geometric accuracy of this product is 5 m CE90 or better, from native positional accuracy of the background satellite image. The estimated thematic accuracy of this product is 85% or better, (choose the most appropriate one) as it is based on visual interpretation of recognizable items on very high resolution optical imagery. Only the area enclosed by the Area of Interest has been analyzed. Map produced on by e-GEOS under contract 4000111723-14-AM with ESA. All products are © of the European Space Agency (ESA).

Image data: SPOT-5 © CNES 2015, Distribution Astrium Services/Spot Image S. A. (acquired on 16/11/2012, GSD 2.5 m, approx. 0% cloud coverage, 29,5' off-nadir). All rights reserved.

Vector data: Base vector layers based on OpenStreetMap © OpenStreetMap contributors, Wikimapia.org, GeoNames (approx. 1:10.000, extracted on 01/01/2001), refined by e-GEOS. Source information is included in vector data.

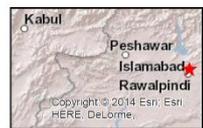
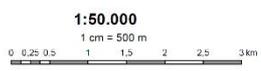
Base map: SPOT-5

| | |
|---|-----------------|
| Area of Interest | Road |
| Reputed Place | Primary Route |
| Associated Transportation Features | Secondary Route |
| Bridge | Local Route |
| Tunnel | Railway |
| Railway | |



Coordinate System: WGS 1984 UTM Zone 42N
 Projection: Transverse Mercator
 Datum: WGS 1984
 False Easting: 500 000 0000
 False Northing: 0 0000
 Central Meridian: 69 0000
 Scale Factor: 0 9996
 Latitude Of Origin: 0 0000
 Units: Meter
 Printed on: 27.07.2015

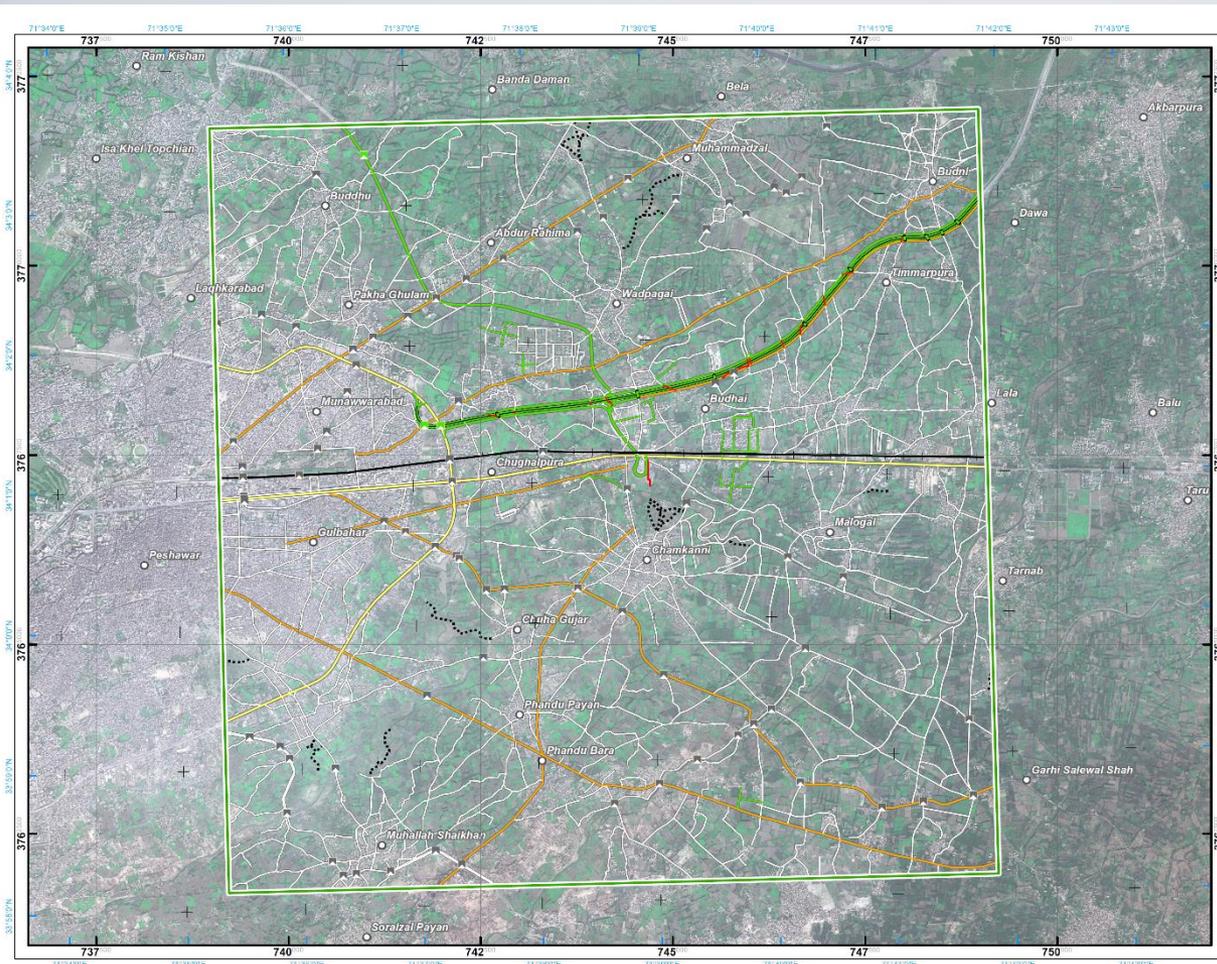
Peshawar - Pakistan
 Transport Infrastructure Map - 16/11/2012



Case Study #1 – Peshawar (Pakistan)



Sample map products - Transport infrastructure inventory and change



EOTAP project:
Collecting Transport Infrastructure Intelligence in Asia and the Pacific
 Contractor: e-GEOS (Italy).

Interpretation: The present map shows the transportation features derived from public datasets, refined by means of visual interpretation of high resolution optical satellite images. In particular the map points out the changes occurred on transportation infrastructure from 31/07/2005 to 16/11/2012. All satellite images have been radiometrically enhanced and orthorectified with RPC approach. The estimated geometric accuracy of this product is 5 m CE90 or better, from native positional accuracy of the background satellite image.

The estimated thematic accuracy of this product is 85% or better, (choose the most appropriate one) as it is based on visual interpretation of recognizable items on very high resolution optical imagery. Only the area enclosed by the Area of Interest has been analyzed. Map produced on by e-GEOS under contract 400011723-14-1-AM with ESA. All products are © of the European Space Agency (ESA).

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Vector data: Base vector layers based on OpenStreetMap © OpenStreetMap contributors, Wikimapia.org, GeoNames (approx. 1:10,000, extracted on 01/01/2001), refined by e-GEOS. Source information is included in vector data.

Base map: SPOT-5

| Legend | Description |
|----------------|-------------------------|
| [Green Box] | Area of Interest |
| [Green Line] | Road |
| [Green Line] | New National Motorway |
| [Green Line] | New Primary Route |
| [Green Line] | New Secondary Route |
| [Green Line] | New Local Route |
| [Red Line] | Removed Secondary Route |
| [Red Line] | Removed Local Route |
| [Yellow Line] | Primary Route |
| [Orange Line] | Secondary Route |
| [Black Line] | Local Route |
| [Dotted Line] | Cart Track |
| [Circle] | Populated Place |
| [Green Square] | New Bridge |
| [Red Square] | Removed Bridge |
| [Black Square] | Bridge |
| [Black Square] | New Tunnel |
| [Black Square] | Removed Tunnel |
| [Black Square] | Tunnel |
| [Black Square] | Railway |
| [Black Square] | Local Railway |

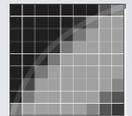
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Pakistan



Quickbird
SPOT-5



2.4 m
2.5 m



31/07/2005
16/11/2012

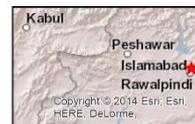
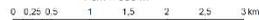
Coordinate System: WGS 1984 UTM Zone 42N
 Projection: Transverse Mercator
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 False Northing: 0,000,000
 Central Meridian: 69,00000
 Scale Factor: 0,99960
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 Units: Meter
 Printed on: 27/07/2015

Peshawar - Pakistan
 Transport Infrastructure Map - Change Detection 31/07/2005-16/11/2012

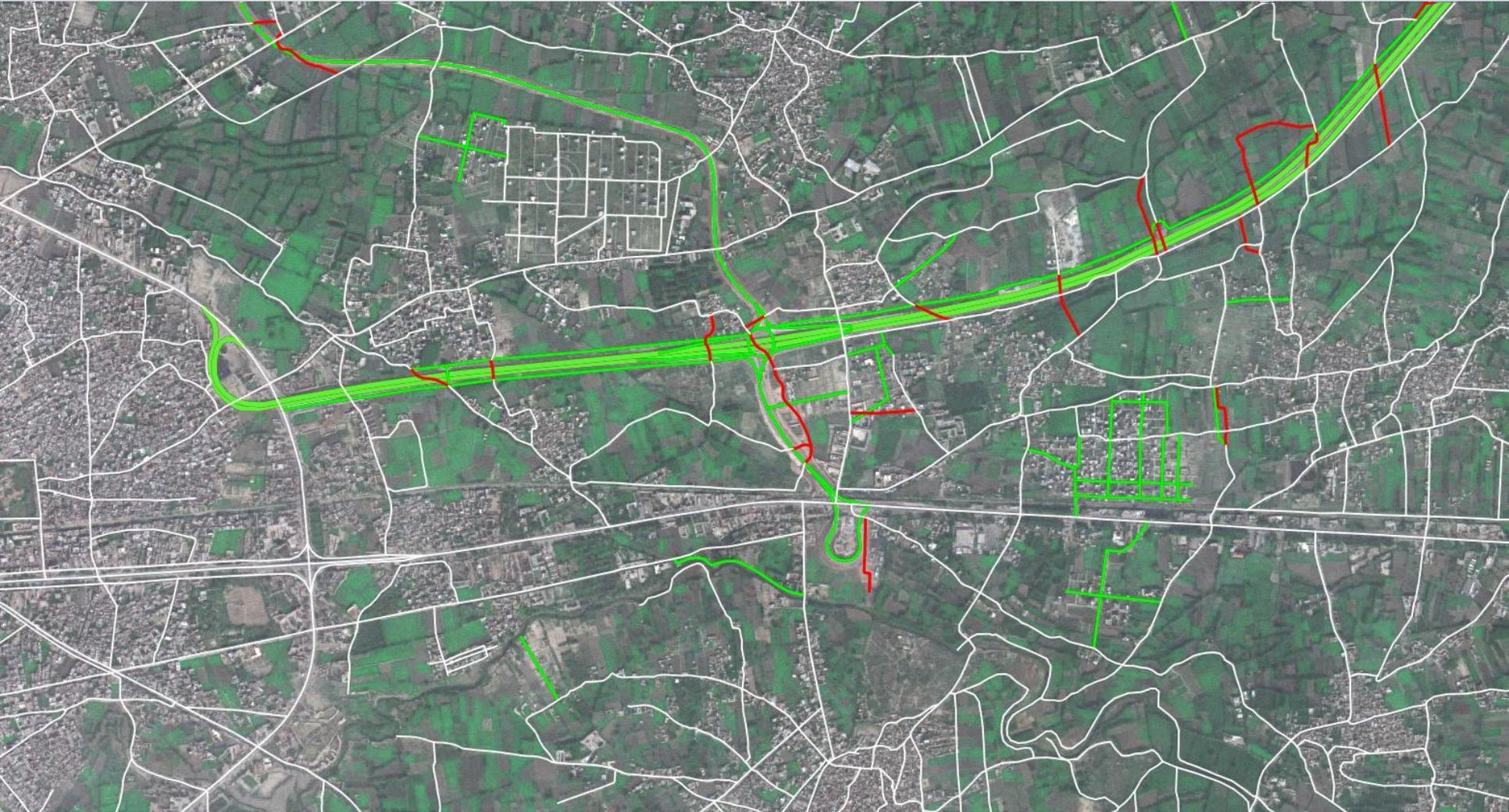


1:50,000

1 cm = 500 m



A closer look to change detection sequence...



Case Study #2 – Baku (Azerbaijan)

Product 1 – Transport infrastructure inventory and change

Area of Interest: 976 km²

Satellite EO data sources:



T0



Quickbird
IKONOS



0,6 m
1 m
2.4 m



2002 - 2005

T1



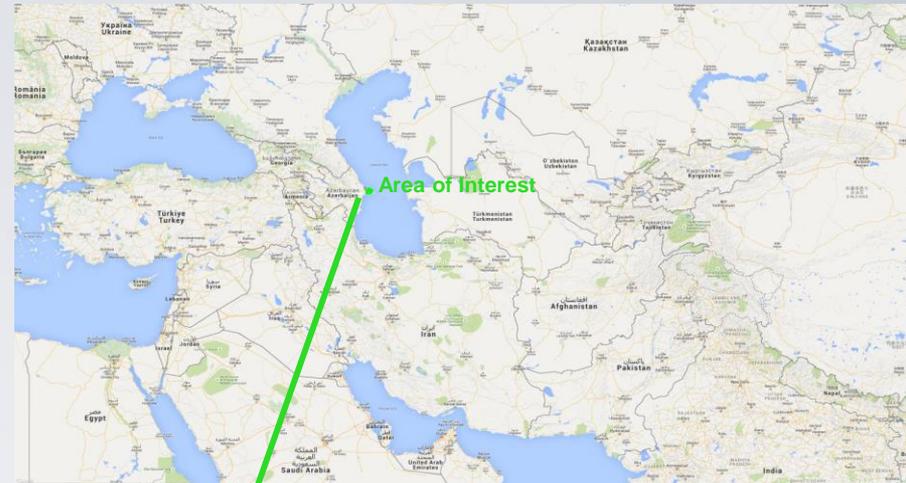
SPOT7



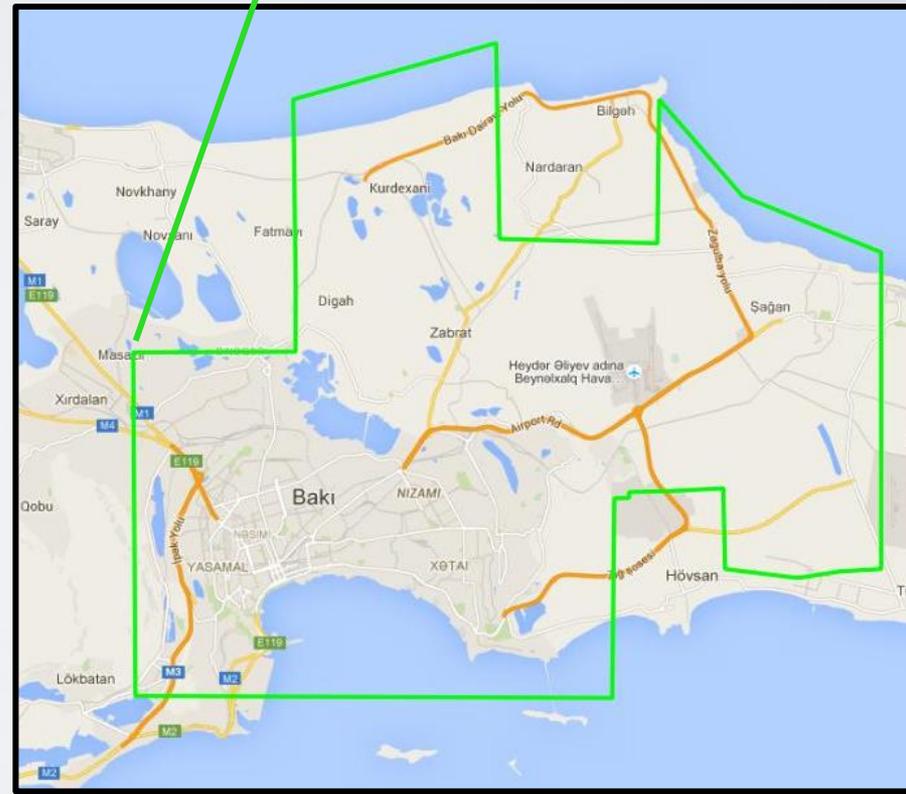
1.6 m



30/12/2014



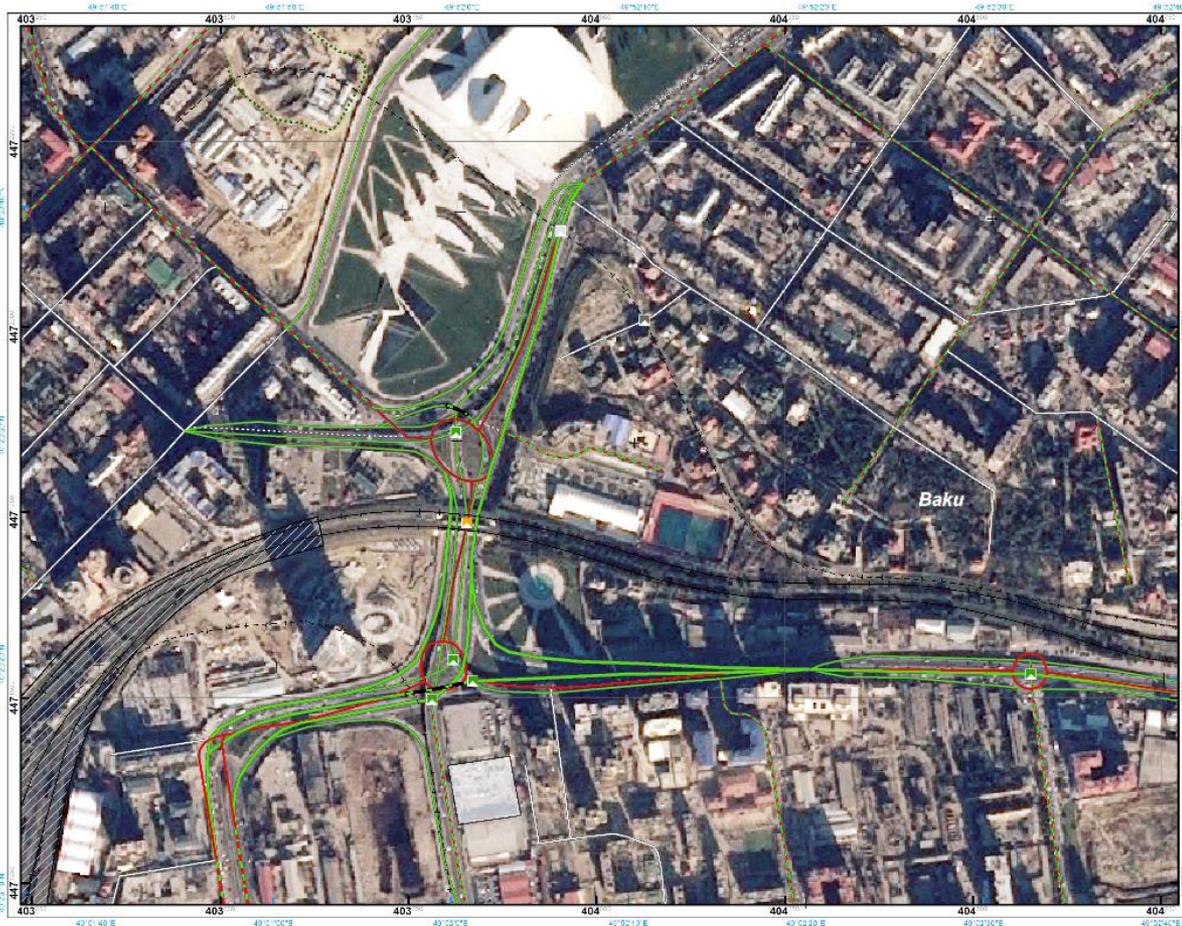
Area of Interest



Case Study #2 – Baku (Azerbaijan)



Sample map products - Transport infrastructure inventory and change



Coordinate System: WGS 1984 - UTM Zone 39N
 Projection: Transverse Mercator
 Datum: WGS 1984
 Spheroid: Spheroid: SRS 8000
 Scale factor: 0.999603
 False Easting: 500000
 False Northing: 0
 Units: Meter

Baku - Azerbaijan
 Transport Infrastructure Map - Change Detection 22/10/2003-30/12/2014

1:5.000
 1 cm = 50 m

0 125 250 Meters



EOTAP project:
Collecting Transport Infrastructure Intelligence in Asia and the Pacific
 Contractor: e-GEOS (Italy)

Interpretation: The present map shows transportation features derived from public datasets, refined by means of visual interpretation of high resolution optical satellite images. In particular the map points out the changes occurred on transportation infrastructure from 22/10/2003 to 30/12/2014. All satellite images have been radiometrically enhanced and orthorectified with RPC approach.
 The estimated geometric accuracy of this product is 0,5 m CE90 or better, from native positional accuracy of the background satellite image.
 The estimated thematic accuracy of this product is 85% or better, as it is based on visual interpretation of recognizable items on very high resolution optical imagery. Only the area enclosed by the Area of Interest has been analyzed.
 Map produced on by e-GEOS under contract 4000111723-14-I-AM with ESA.
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Image data: SPOT-7 © CNES 2015, Distribution Astrium Service/Spot Image S.A. (acquired on 30/12/2014, GSD 1,6 m, approx. 0% cloud coverage, 2° off nadir). All rights reserved.

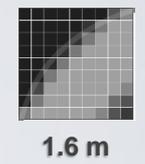
Vector data: Base vector layers based on OpenStreetMap @ OpenStreetMap contributors, Wikimapia.org, GeoNames (approx. 1:10.000, extracted on 01/01/2001), refined by e-GEOS.

Inset maps based on: Administrative boundaries (JRC 2013, GISCO 2010 @ EuroGeographics), Hydrology, Transportation (Natural Earth, 2012, CCM River DB @ EU JRC 2007). Source information is included in vector data.

Base map: SPOT-7

| | |
|--|---|
| <ul style="list-style-type: none"> ○ Point Road — Primary Route, New — Primary Route, Modified — Primary Route, Disappeared — Secondary Route, Modified — Secondary Route, Disappeared — Local Route, Unchanged — Local Route, New — Local Route, Modified — Local Route, Disappeared — Canal Track, New | <ul style="list-style-type: none"> Associated Transportation Area ■ Bridge, Unchanged ■ Bridge, Modified ■ Bridge, New ■ Bridge, Disappeared ■ Tunnel, New ■ Vehicle Lot Area, Unchanged Railway — Railway, Unchanged — Railway, Disappeared □ Railway Yard, Unchanged |
|--|---|

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Case Study #2 – Baku (Azerbaijan)

Product 2 – Population estimation

Area of Interest: 82 km²



1 km radius centered in each of the 27 potential stations of the new metro line alignments.

Satellite EO data sources:



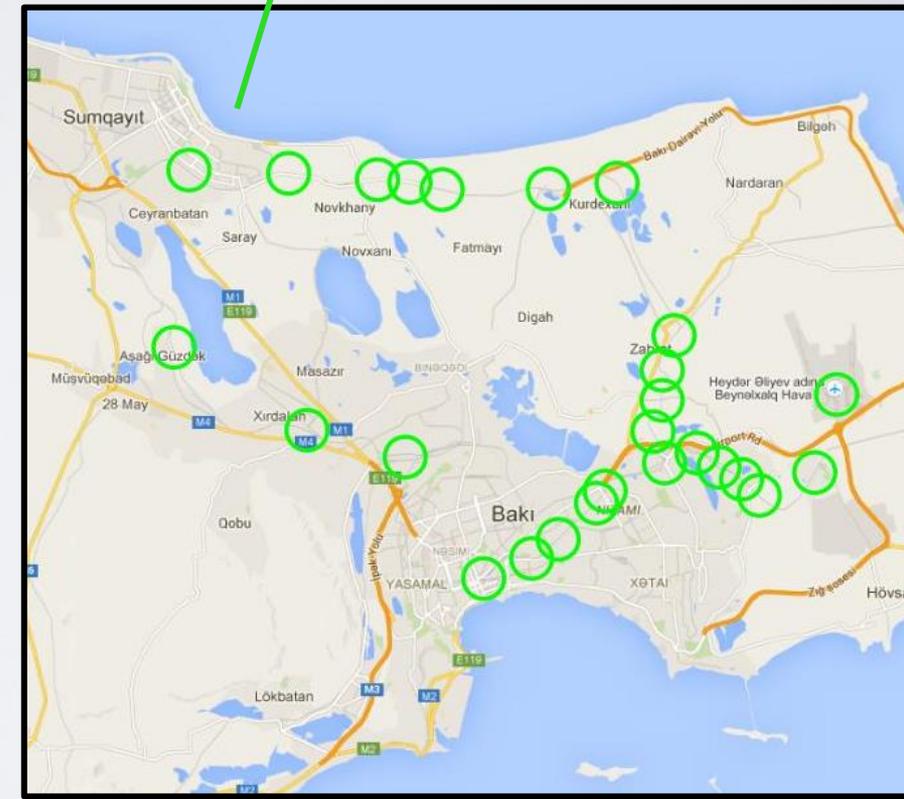
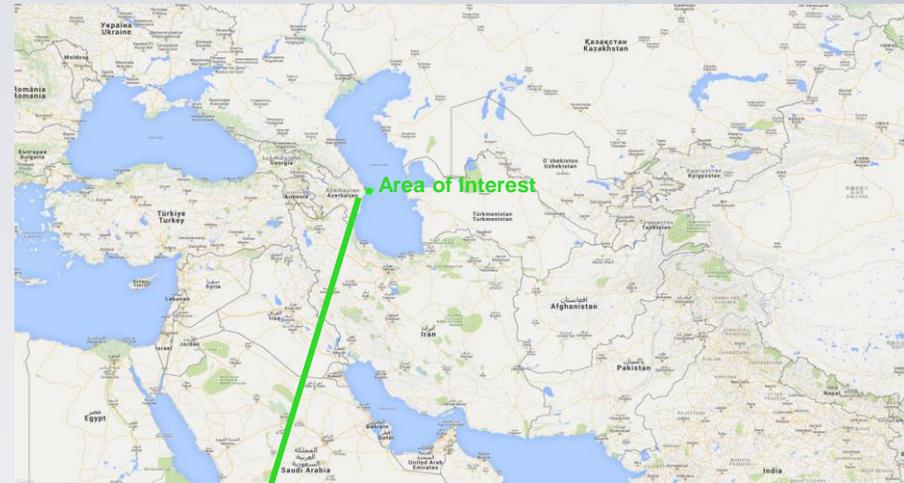
SPOT7



1.6 m



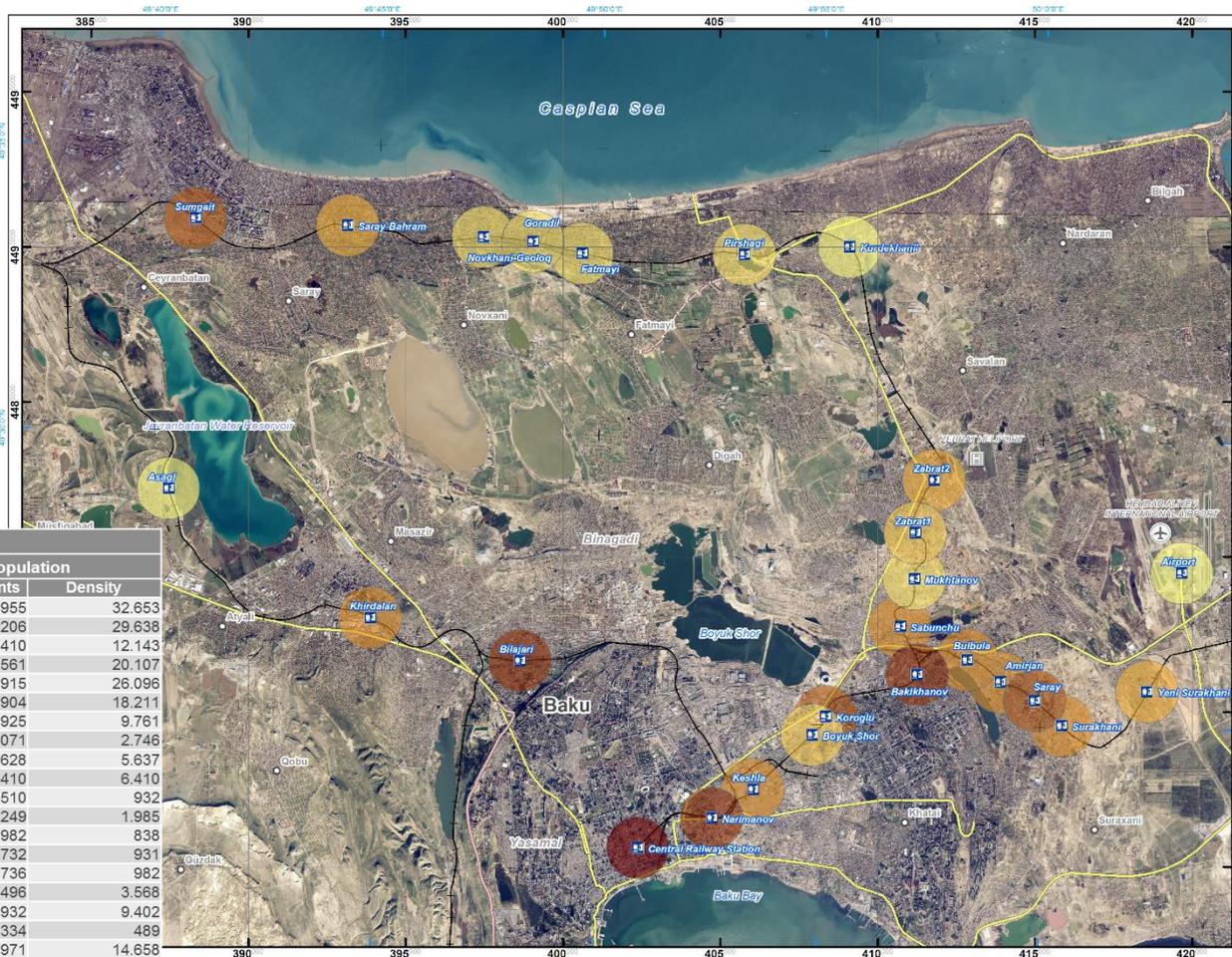
30/12/2014



Case Study #2 – Baku (Azerbaijan)



Sample map products - Population estimation



EOTAP project:
Collecting Transport Infrastructure Intelligence in Asia and the Pacific
 Contractor: e-GEOS (Italy)

Interpretation: This overview map show the current situation of railway station of Baku city area; refined by means of visual interpretation of high resolution optical satellite images. The graphics shows the current estimated population close to each railway station of Baku, within a circle of 1 km radius, in particular the number of people for each station. All satellite images have been radiometrically enhanced and orthorectified with RPC approach. The estimated geometric accuracy of this product is 1,6 m CE90 or better, from native positional accuracy of the background satellite image. The estimated thematic accuracy of this product is 85% or better, as it is based on visual interpretation of recognizable items on very high resolution optical imagery. Only the area enclosed by the Area of Interest has been analyzed. Map produced on by e-GEOS under contract 400011723-14-I-AM with ESA. All products are © of the European Space Agency (ESA).

Image data: SPOT-7 © CNES 2015, Distribution Astrium Service/Spot Image S.A. (acquired on 30/12/2014, GSD 1,6 m, approx. 0% cloud coverage) and SPOT-6 © CNES 2015, Distribution Astrium Service/Spot Image S.A. (acquired on 16/10/2012, GSD 1,6 m, approx. 0% cloud coverage. All rights reserved.

Base map: SPOT 7 / SPOT 6

| Legend | |
|---|-------------------|
| General Information | Population |
| ○ village | <1000 |
| Transportation | 1000 - 3500 |
| ✈ Airport | 3500 - 9000 |
| ✈ Heliport | 9000 - 12000 |
| 🚂 Train Stations | 12000 - 20000 |
| 🚂 Railway Line | 20000 - 30000 |
| 🛣 Primary Road, Fully Functional | 30000 - 40000 |
| 🛣 National Motorway, Fully Functional | >40000 |
| 🛣 National Motorway, Under Construction | |

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| Baku railway stations | | |
|-----------------------|-------------------|---------|
| | Population | |
| | N. of inhabitants | Density |
| Central Railway | 48.955 | 32.653 |
| Narimov | 36.206 | 29.638 |
| Keshla | 14.410 | 12.143 |
| Boyuk Shor | 8.561 | 20.107 |
| Koroglu | 21.915 | 26.096 |
| Bakikhanov | 30.904 | 18.211 |
| Sabunchu | 19.925 | 9.761 |
| Mukhtanov | 3.071 | 2.746 |
| Zabrat 1 | 7.628 | 5.637 |
| Zabrat 2 | 9.410 | 6.410 |
| Kurdenkhanii | 1.510 | 932 |
| Pirshagi | 3.249 | 1.985 |
| Fatmayi | 1.982 | 838 |
| Goradi | 1.732 | 931 |
| Novkhani-Geoloq | 2.736 | 982 |
| Saray-Bahram | 10.496 | 3.568 |
| Sumgait | 25.932 | 9.402 |
| Asagi | 334 | 489 |
| Khirdalan | 14.971 | 14.658 |
| Bilajari | 31.875 | 17.943 |
| Bulbula | 16.597 | 9.424 |
| Amirjan | 18.202 | 10.894 |
| Saray | 22.676 | 14.480 |
| Surakhani | 16.593 | 13.884 |
| Yeni Surakhani | 10.633 | 5.976 |
| Airport | 0 | 0 |

Baku - Azerbaijan
 Product 1 - Estimated Population Map

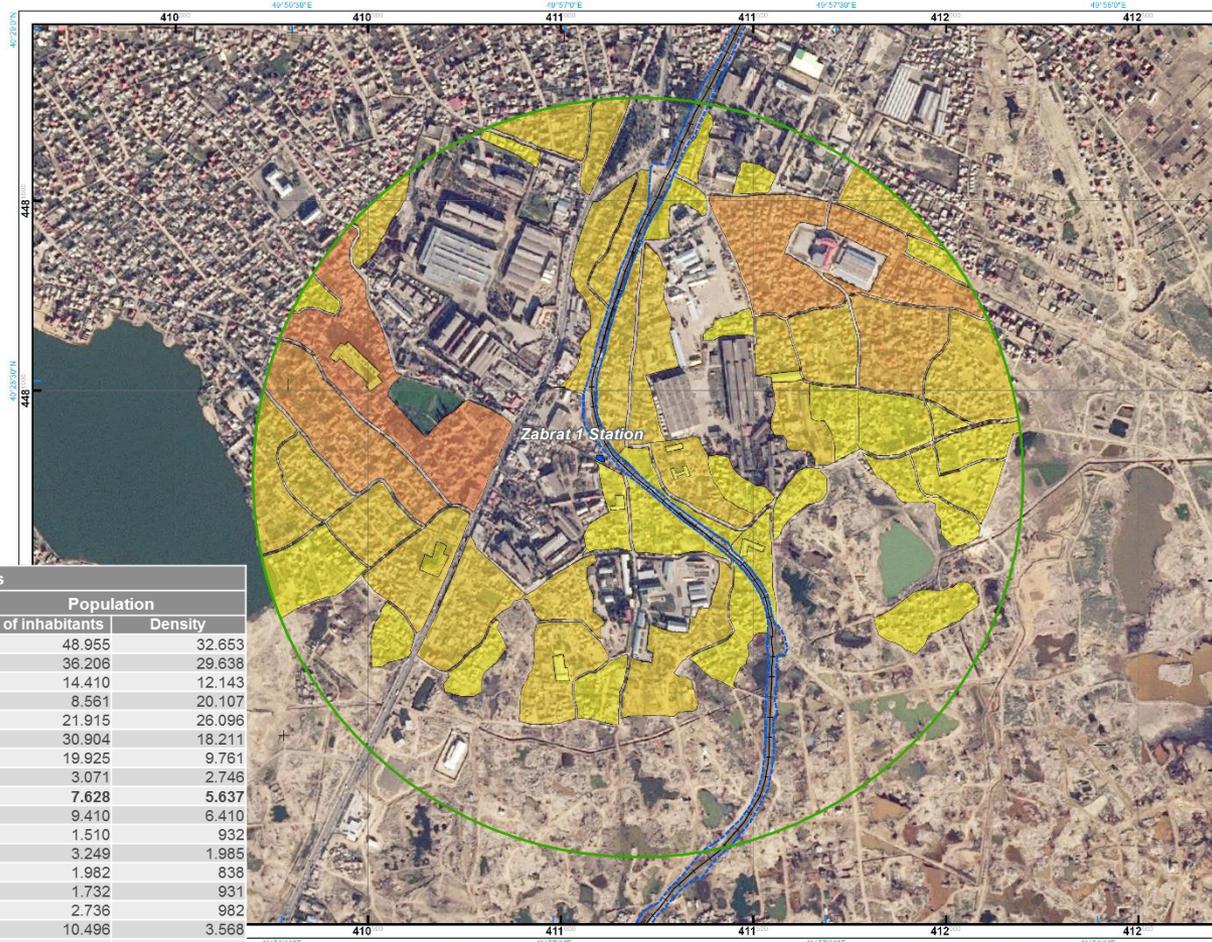
1:125.000
 1 cm = 1,250 m



Case Study #2 – Baku (Azerbaijan)



Sample map products - Population estimation



EOTAP project:
Collecting Transport Infrastructure Intelligence in Asia and the Pacific
 Contractor: e-GEOS (Italy)

Interpretation: The present map show an estimate of the current population close to each railway station of Baku, within a circle of 1 km radius, in particular the number of people for each building block; refined by means of visual interpretation of high resolution optical satellite images.
 All satellite images have been radiometrically enhanced and orthorectified with RPC approach.
 The estimated geometric accuracy of this product is 1,6 m CE90 or better, from native positional accuracy of the background satellite images.
 The estimated thematic accuracy of this product is 85% or better, as it is based on visual interpretation of recognizable items on very high resolution optical imagery. Only the area enclosed by the Area of Interest has been analyzed.
 Map produced on by e-GEOS under contract 4000111723-14-I-AM with ESA.
 All products are © of the European Space Agency (ESA).

Image data: SPOT-7 © CNES 2015. Distribution Astrum Service/Spot Image S.A. (acquired on 30/12/2014, GSD 1,6 m, approx. 0% cloud coverage). All rights reserved.

Base map: SPOT 7

| General Information | Estimated population |
|------------------------|----------------------|
| Area of Interest | 0 - 100 |
| Railway Line | 100 - 250 |
| Transportation Station | 250 - 400 |
| Railway Row Area | 400 - 750 |
| | 750 - 1000 |

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| Koroglu | 21.915 | 26.096 |
| Bakikhanov | 30.904 | 18.211 |
| Sabunchu | 19.925 | 9.761 |
| Mukhtanov | 3.071 | 2.746 |
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| Zabrat 2 | 9.410 | 6.410 |
| Kurdenkhanii | 1.510 | 932 |
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| Fatmayi | 1.982 | 838 |
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| Novkhani-Geoloq | 2.736 | 982 |
| Saray-Bahram | 10.496 | 3.568 |
| Sumgait | 25.932 | 9.402 |
| Asagi | 334 | 489 |
| Khirdalan | 14.971 | 14.658 |
| Bilajari | 31.875 | 17.943 |
| Bulbula | 16.597 | 9.424 |
| Amirjan | 18.202 | 10.894 |
| Saray | 22.676 | 14.480 |
| Surakhani | 16.593 | 13.884 |
| Yeni Surakhani | 10.633 | 5.976 |
| Airport | 0 | 0 |

Baku - Azerbaijan

Product 1 - Population Density Map

1:10.000

1 cm = 100 m

0 250 500 Meters



Case Study #2 – Baku (Azerbaijan)

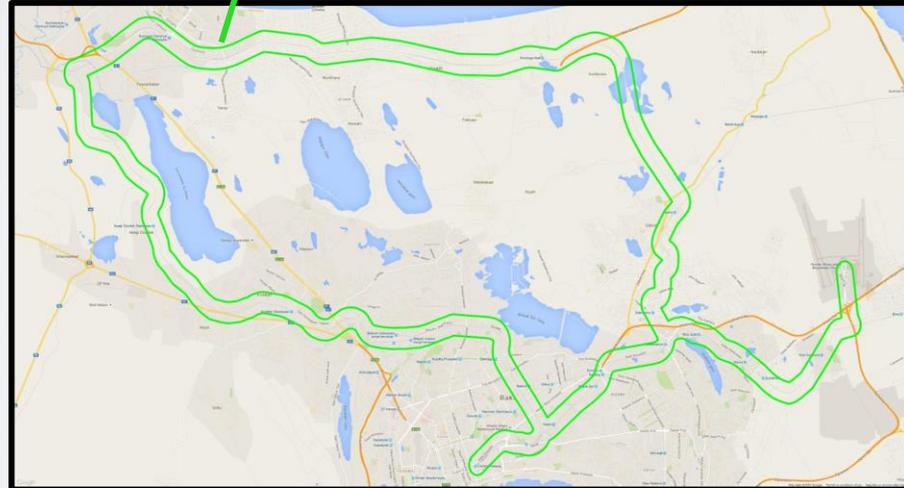
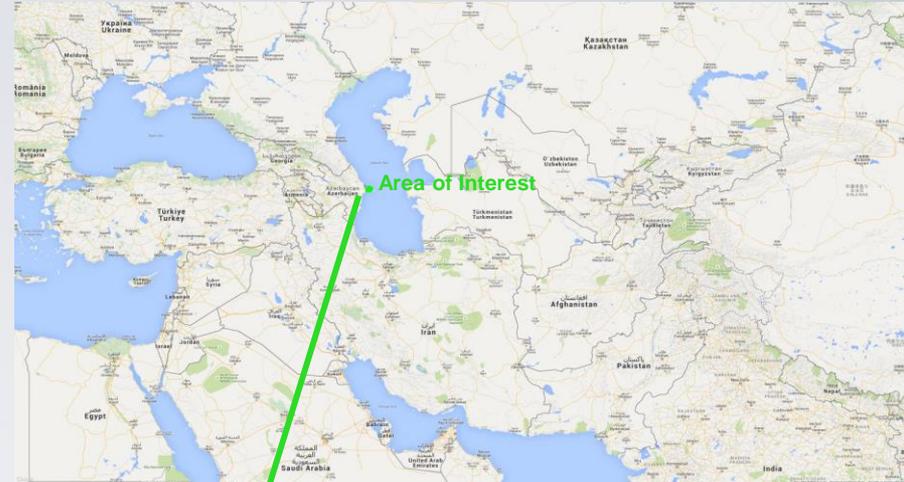
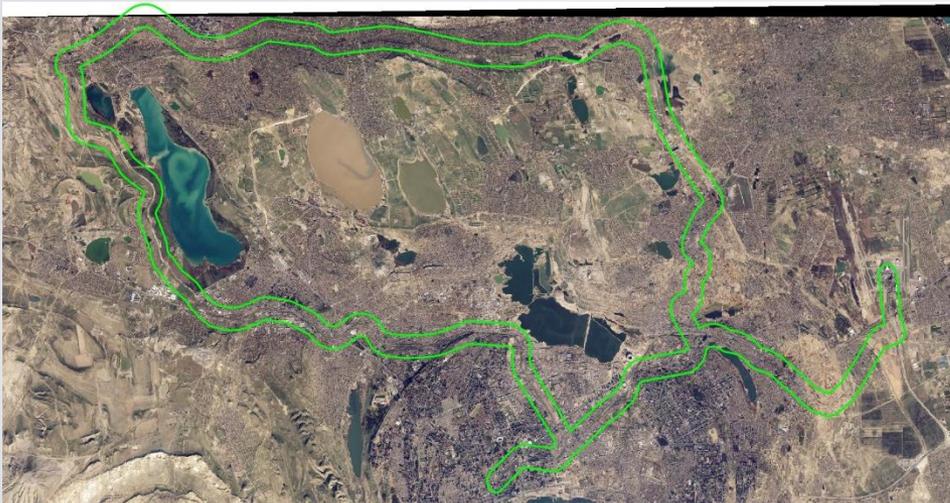
Product 3 – Detailed Land Use mapping

Area of Interest: 82 km²



500 m buffer left/right of the railway alignment

Satellite EO data sources:



SPOT7

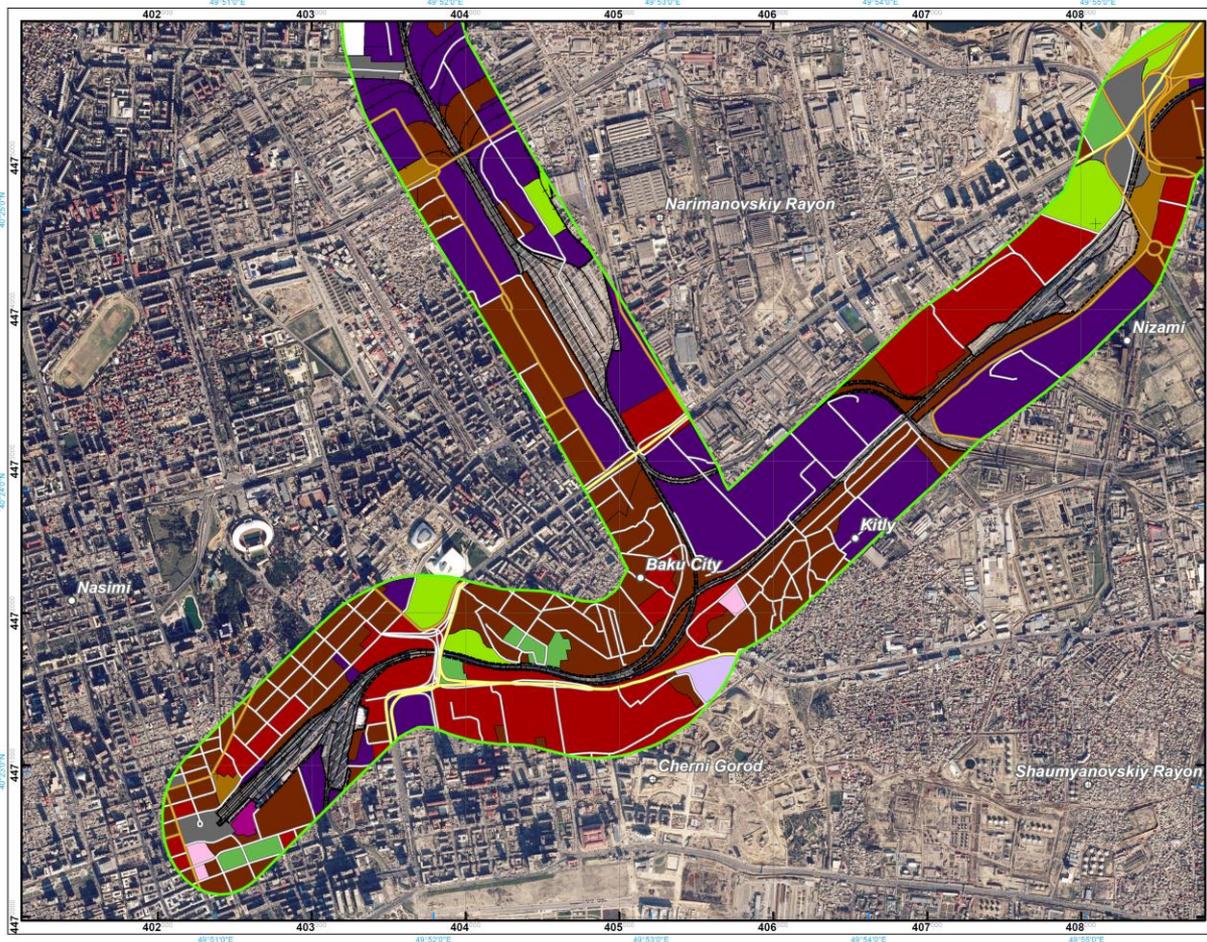


1.6 m



30/12/2014

Sample map products – Detailed Land Use mapping



EOTAP project:
Collecting Transport Infrastructure Intelligence in Asia and the Pacific
 Contractor: e-GEOS (Italy).

Interpretation: The present map show a detailed picture of the current land use along the planned track of the railway area of Baku, focusing especially on non residential elements (such as depots, non-residential buildings, transportation network and land cover) analyzed in a buffer distance of 500 m left/right from main railway line; refined by means of visual interpretation of high resolution optical satellite images.
 All satellite images have been radiometrically enhanced and orthorectified with RPC approach.
 The estimated geometric accuracy of this product is 1,6 m CE90 or better, from native positional accuracy of the background satellite image.
 The estimated thematic accuracy of this product is 85% or better, as it is based on visual interpretation of recognizable items on very high resolution optical imagery. Only the area enclosed by the Area of Interest has been analyzed.
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 All products are © of the European Space Agency (ESA).

Image data: SPOT-7 © CNES 2015, Distribution Astrium Service/Spot Image S.A. (acquired on 30/12/2014, GSD 1,6 m, approx. 0% cloud coverage). All rights reserved.

Base map: SPOT 7

| General Information | | Built Up Area | |
|--|--|---|---|
| Area of Interest | Population Place | Residential | Commercial |
| Primary Route | Secondary Route | Industrial | Educational |
| Local Route | Railway Line | Transportation | Recreational |
| Railway Yard Area | Railway Right of Way Area | Urbanized Multi-Functional | Park Area |
| | | Other | Bare Soil |



Azerbaijan



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Coordinate System: WGS 1984 UTM Zone 39N
 Projection: Transverse Mercator
 Datum: WGS 1984
 false easting: 500 000,0000
 false northing: 0,0000
 central meridian: 51 0000
 scale factor: 0,9996
 latitude of origin: 0,0000
 Units: Meter

Baku - Azerbaijan
 Product 04 - Detailed Land Use Map



Case Study #2 – Baku (Azerbaijan)



Sample map products – Detailed Land Use mapping



Coordinate System: WGS 1984 UTM Zone 39N
 Projection: Transverse Mercator
 Datum: WGS 1984
 false easting: 500 000.0000
 false northing: 0.0000
 central meridian: 51.0000
 scale factor: 0.9996
 latitude of origin: 0.0000
 Units: Meter

Baku - Azerbaijan
 Product 02 - Detailed Land Use Map

1:10.000
 1 cm = 100 m

Printed on 13/08/2015



eotap
 earth observation for a transforming asia pacific

EOTAP project:
Collecting Transport Infrastructure Intelligence in Asia and the Pacific
 Contractor: e-GEOS (Italy).

Interpretation: The present map show a detailed picture of the current land use along the planned track of the railway area of Baku, focusing especially on non residential elements (such as depots, non-residential buildings, transportation network and land cover) analyzed in a buffer distance of 500 m left/right from main railway line; refined by means of visual interpretation of high resolution optical satellite images.

All satellite images have been radiometrically enhanced and orthorectified with RPC approach.

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Map produced on by e-GEOS under contract 400011723-14-I-AM with ESA.

All products are © of the European Space Agency (ESA).

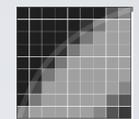
Image data: SPOT-7 © CNES 2015, Distribution Astrium Service/Spot Image S.A. (acquired on 30/12/2014, GSD 1,6 m, approx. 0% cloud coverage) All rights reserved.

Base map: SPOT 7

| General Information | General Building | Other Land Cover |
|-----------------------------|-------------------------|-----------------------|
| Area of Interest | Museum | Park Area |
| Point of Interest | Freighting | Reservoir Area |
| Transportation | Utilities | Lake Area |
| Secondary Route | Commerce | Thicket Area |
| Local Route | Education | Bare Soil |
| Railway Line | Human Health Activities | Other Features |
| Railway Right of Way Area | Law Enforcement | Ditch Line |
| Transportation Station | Manufacturing | Storage Tank Area |
| Vehicle Lot Area | Religious Activities | Stadium Area |
| Built Up Area | Restaurant | Power Substation Area |
| Residential | Spa Centre | |
| Commercial | Transport | |
| Educational | Warehousing and Storage | |
| Industrial | Other | |
| Medical | | |
| Recreational | | |
| Unbalanced Multi-Functional | | |
| Other | | |



Azerbaijan



1.6 m



30/12/2014

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Case Study #3 – Suva (Fiji)

Product 1 – Transport infrastructure inventory and change

Area of Interest: 265 km²

Satellite EO data sources:



Quickbird
IKONOS

0,6 m
1 m

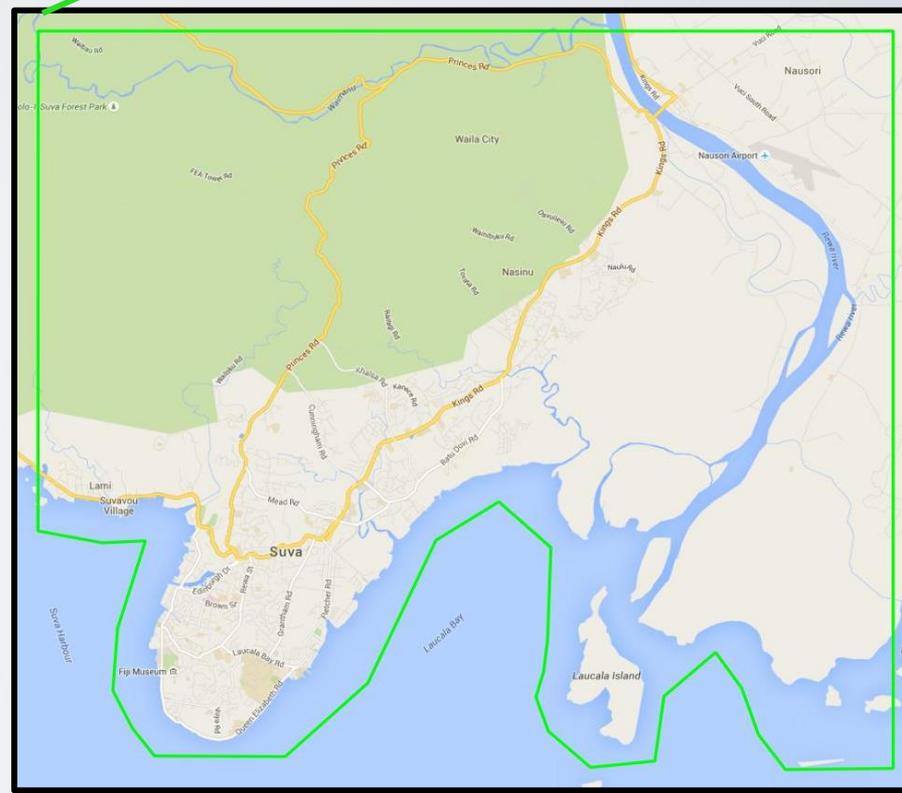
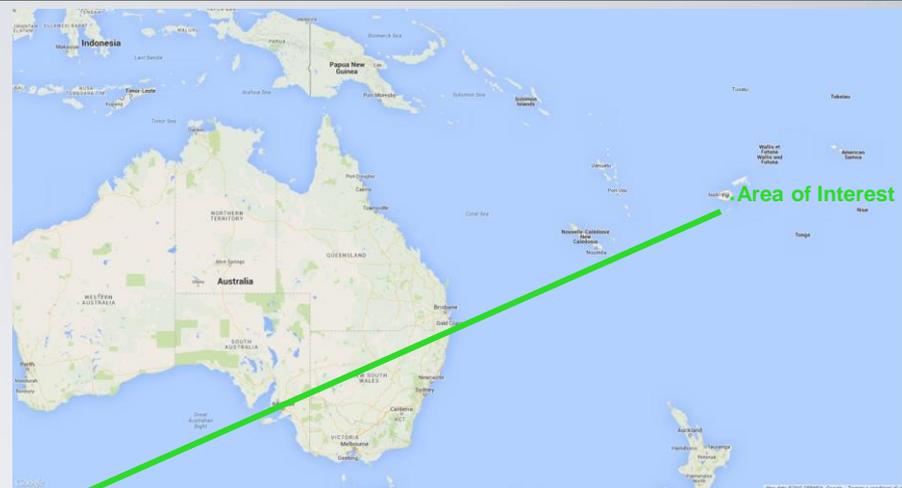
27
2004 - 2005

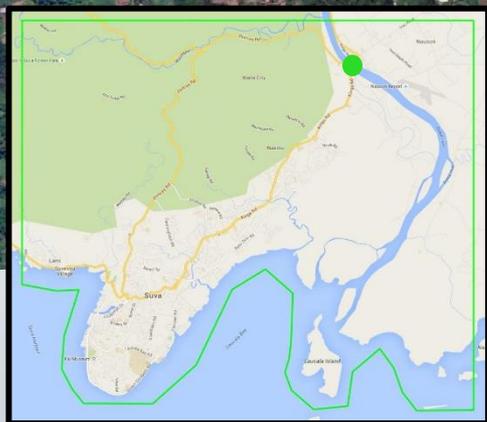


WorldView-2
GeoEye-1

2 m

27
2010 - 2014



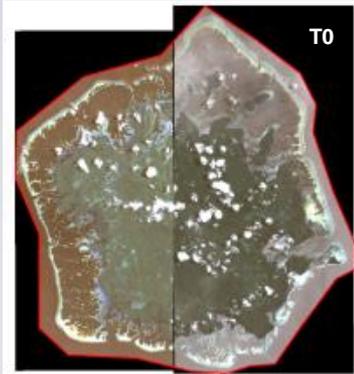


Case Study #4 – Pohnpei (Micronesia)

Product 1 – Transport infrastructure inventory and change

Area of Interest: 814 km²

Satellite EO data sources:



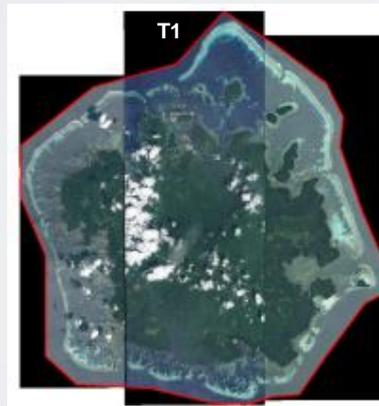
T0



2,4 m



2005



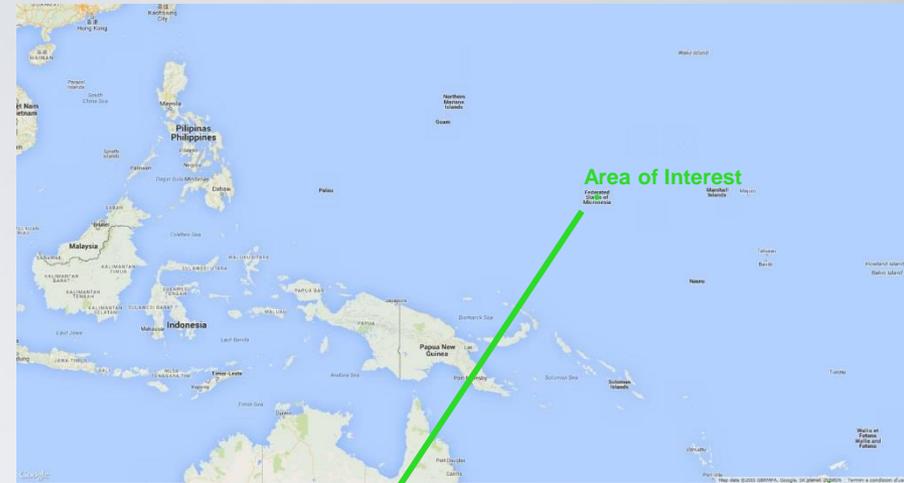
T1



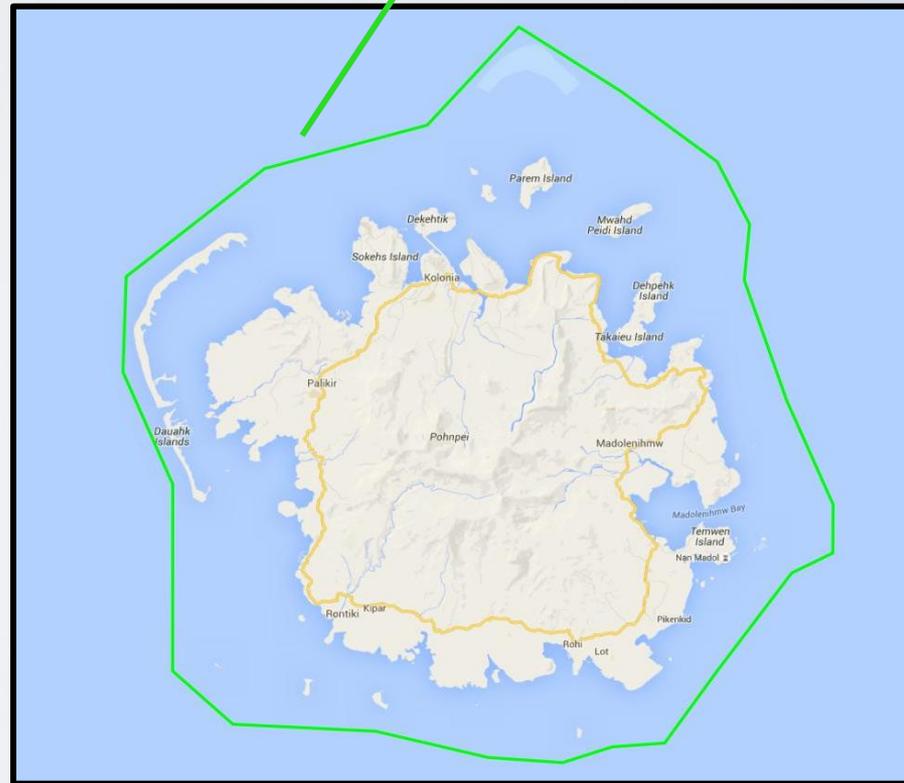
2 m



2010 - 2012



Area of Interest



Potential use of EO based services within Asian Development Bank (ADB)

- **Strategic planning:** Transport Infrastructure Inventory products enable ADB and its member countries to improve the quality of data used during the phase of strategic planning of new investments and intervention, allowing the identification of priorities based on an objective, homogeneous and updated picture.
- **Feasibility study&Design:** Population estimation and Detailed Land use products support the study and design phases of new local transport infrastructure development projects
- **Asset mapping:** apart from transport specific applications, all products contribute to an important task in DRR which is asset mapping. The availability of across-country homogeneous data about transport infrastructure would enable the refinement of multi-hazard risk models and a major step forward in this domain.
- **Contingencies planning:** the availability of updated transport infrastructure data also enables the improvement of contingency plans in case of natural and man made disasters.

Value of EO against traditional methods

- **Objectivity:** the results are objectively derived from the analysis of satellite images, the bias is very limited
- **Cost effectiveness:** the costs is generally lower, especially for large area mapping projects
- **Comparability of results:** cross-country and/or multitemporal results can be easily compared and evaluated



Thank you!
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