Urban Workshop on Satellite Earth Observation and Geospatial Data
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World Bank HQ, Washington DC, USA

Monitoring Urbanization in Latin American Metropolitan Areas (Bogota, Quito and Lima)

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Company facts

- founded in 1961, ~ 1,000 employees, Ottobrunn/ Germany
- high-level engineering and testing

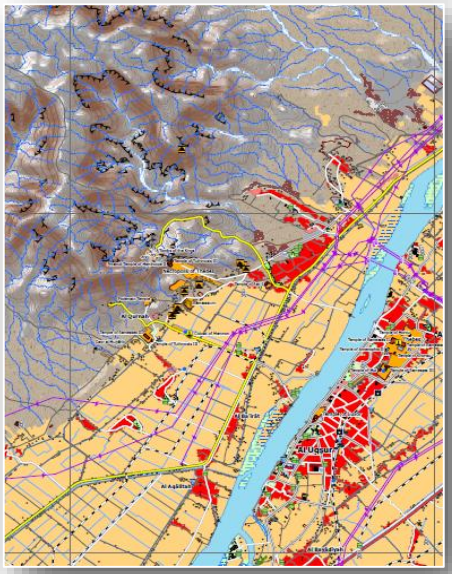
Geodata Factory Dresden, Germany

- **70 employees**, ~ 30 projects per anno
- **Service provider** in remote sensing, geoinformatics and photogrammetry,
- **Markets**: defense and security, cadastral & surveying, land planning, environmental protection, water management, forestry, telecommunications
- **Customers** are public authorities, enterprises, armed forces
- **Disciplines:** geography, cartography, geo-informatics, geodesy, geo-ecology, geology, forestry, geophysics, chemistry, etc.

Services & References

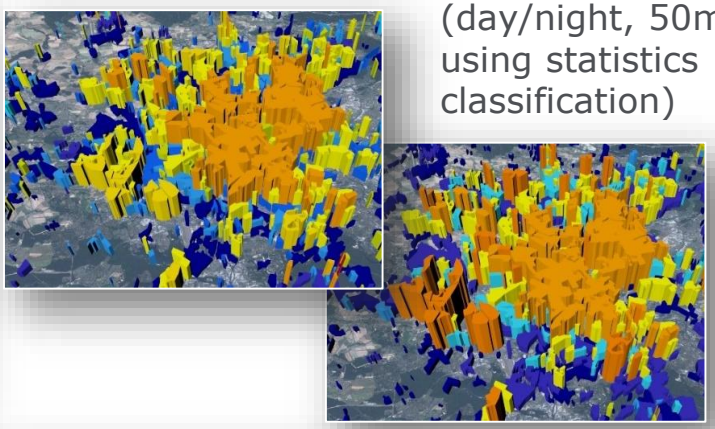
Thematic Mapping

- Interpretation of VHR EO data
- 181 feature types (LandUse/ LandCover, infrastructure)
- Implementation of related info (GeoNames, DTM, …)
- Multi-phase Quality Mngmt.
- 150,000 km²/year, >1,000,000 km road network



… & GIS Analysis

- population density dataset, Germany (day/night, 50m, using statistics classification)



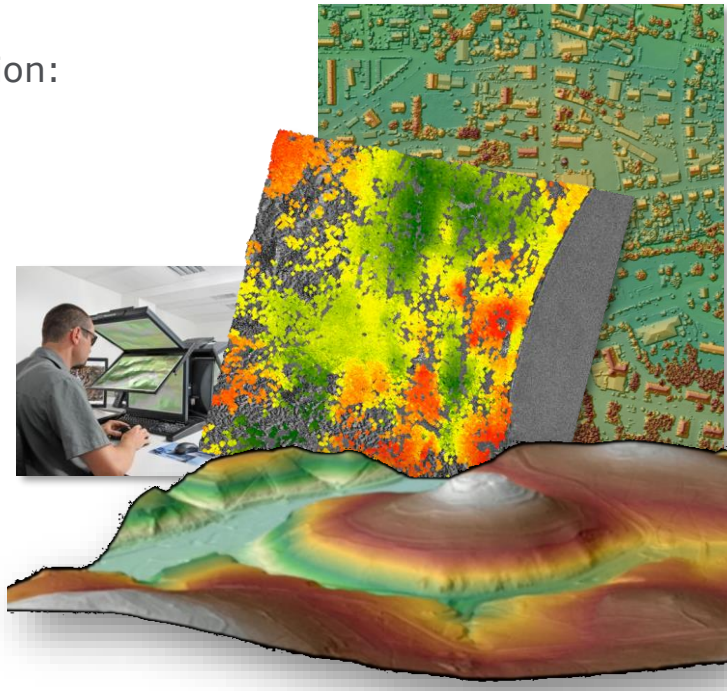
Update of official topographic GIS

- official Digital Landscape Model of Germany. Based on topo ATKIS data of the German Survey 2009
- Multi-temporal & -spectral update with EOdata 2012
- Result: Automatic deduction of CORINE for Germany
- semantic transformation model & object-oriented image-classification
- high quality requirements (97.5% per class)
- 360,000 km² edited in 9 months

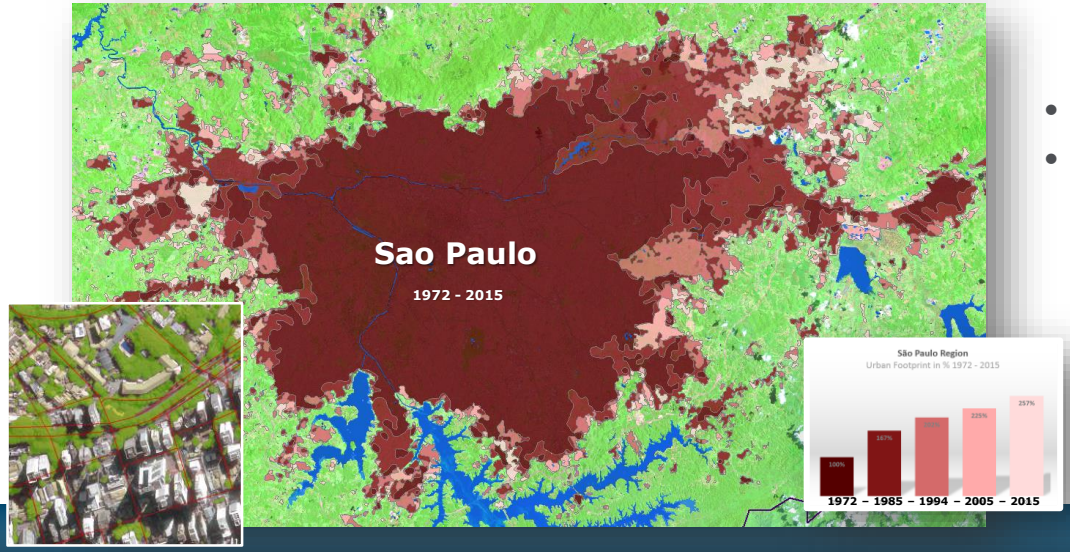
Services & References

Terrain related Analysis

- Digital Terrain Model from EOdata … precise geodetic information:
  "the goal defines technique & scale"
- 3D calculation (amount of water outflow, water levels, drainage calculation)
- support Risk prevention & demonstrator of (hazardous) events (potential landslide areas, flood risk)
- Identification of deformation events (ground water extraction, volcanism, …)



Analysis & Modelling



- Urban development
- Green & Blue aspects (distribution, connectivity)

Consulting, Training & Workshops

… & Software solutions

Background: The World Bank Project

Monitoring Urbanization in Latin American Metropolitan Areas

- **Main WB contact:**
  Felipe Targa, Department for Transport & ICT

- **WB team members:**
  Tatiana Peralta Quiros, Department for Transport & ICT
  Bishwa Raj Pandey, Department for Transport & ICT
  (Catalina Marulanda, Social, Urban, Rural & Resilience)

- **Project users/promoters:**
  applied for internal analysis,
  Daniel Páez (Universidad de los Andes)

- **Project context:**
  fast urban development ⇔ suitable reference data
  for decision making process
  ⇨ Goal: **preparing standardized up-to-date Urban Services**

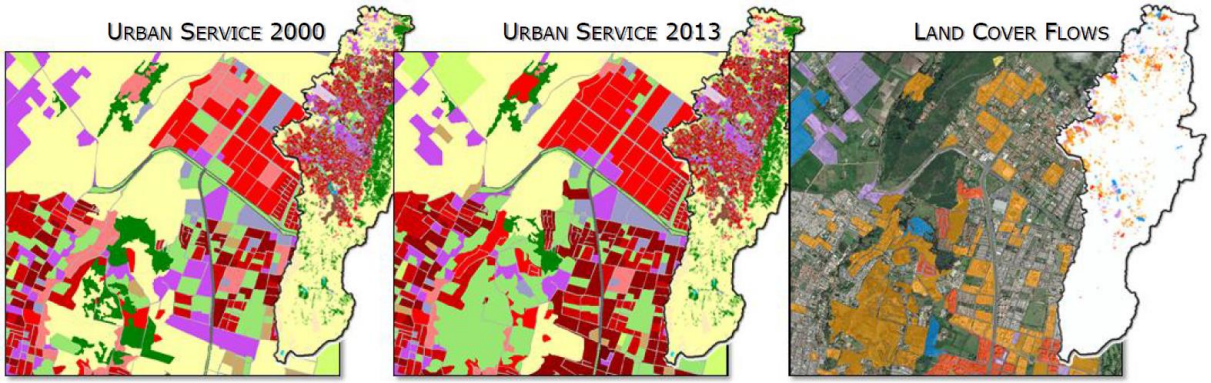
- **Bench mark & Schedule:**
  Service definition phase ⇨ Production phase ⇨ Assessment
  start June 2014; delivery June 2015
  Focus on urban structures, large area, high LOD & Quality

© http://www.paxgaea.com/images/Lima.jpg

Background: The World Bank Project

Monitoring Urbanization in Latin American Metropolitan Areas

- Key requirements (WB/ Scope of Work):
  - Urban Mapping of 2000 & 2013, Change Layer
  - emphasis on Urban structures & Land Use
    → expanding to administrative units

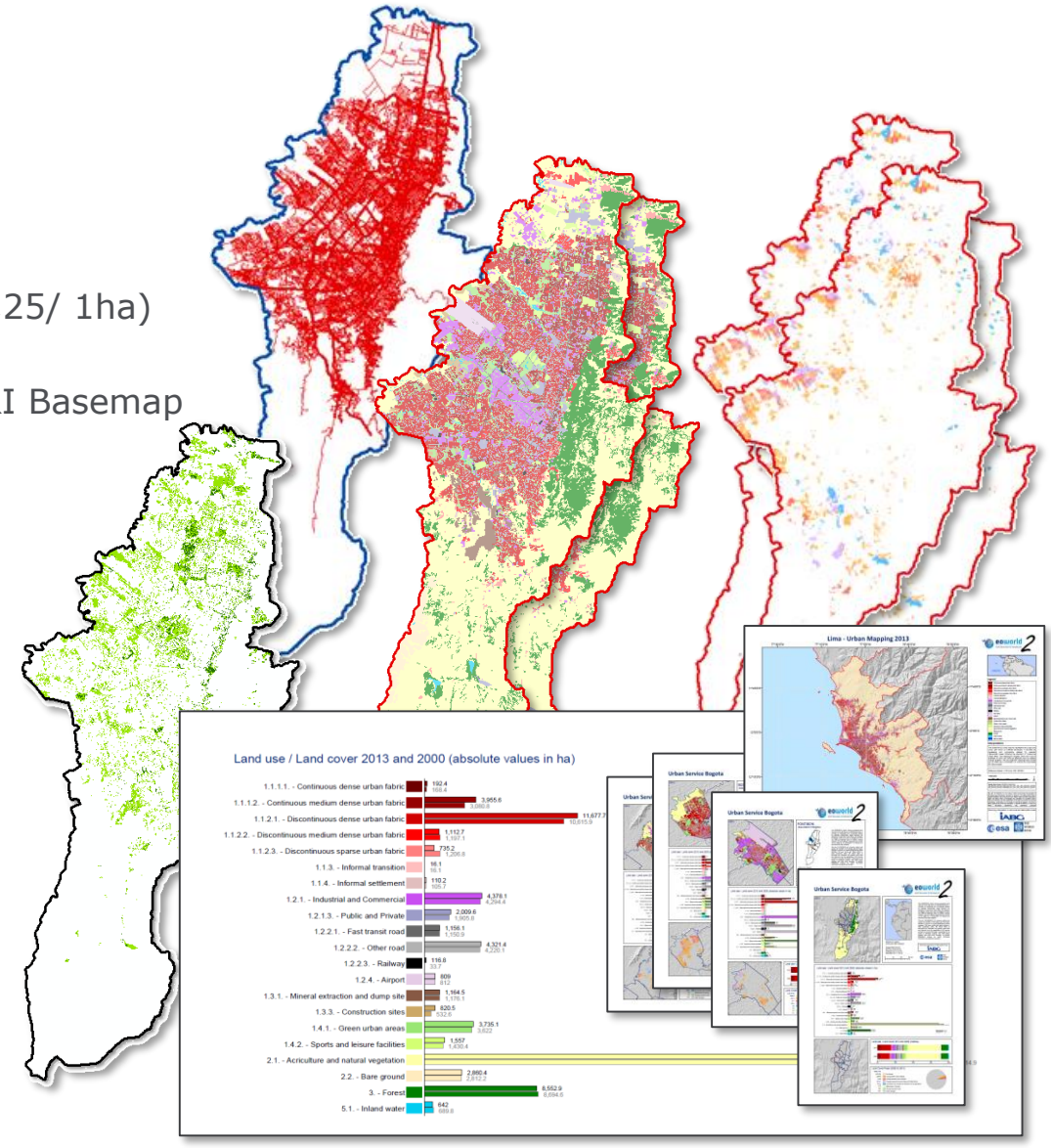


- Additional requirements (WB):
  - transportation network & real footprint
  - higher detail for selected features (Vegetation, informal housing)

  - building heights (VHR analysis)
  - Exceeding time range (back & forth)
  - Larger extent (changing areas are often "outside")

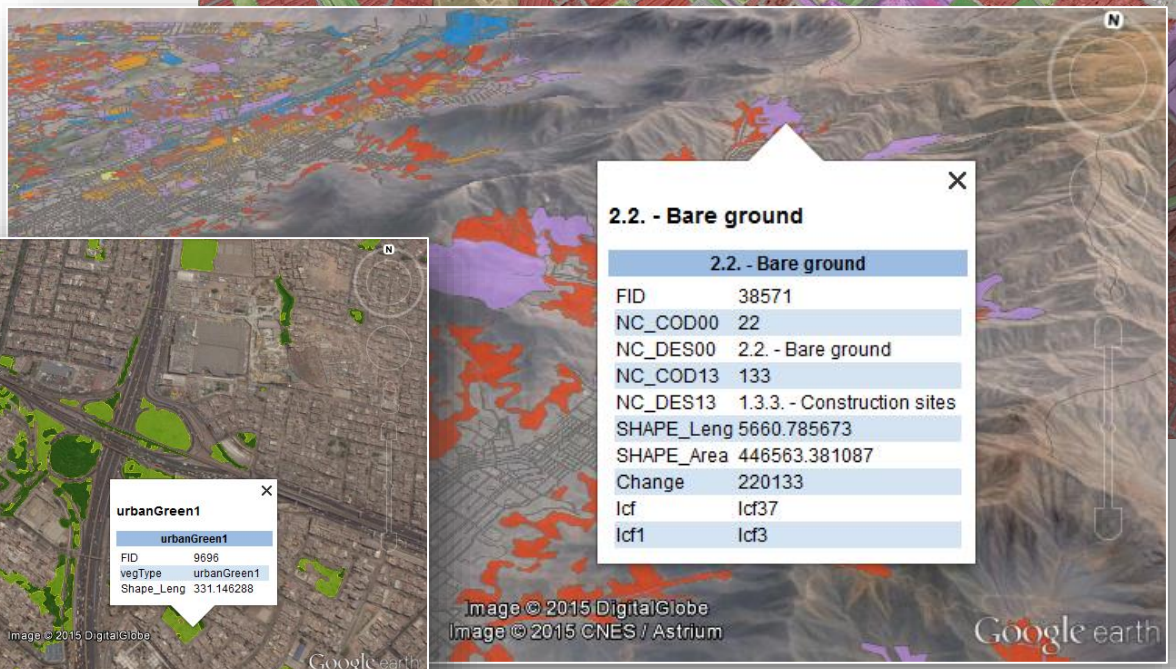
The EO Products: What They Are

- Transportation network 2013
  - buffering (>10m, 3m intervals)
  - Fast transit road, Other road; Railroad
- Urban Service 2013 and 2000
  - Urban Atlas (minimum mapping unit 0,25/ 1ha)
  - 18 urban classes, 5 other classes
  - geometric reference Google Maps/ ESRI Basemap
  - thematic accuracy > 96 %
  - cities: 71,800 polygons
- Urban Change Layer
  - detailed
  - LEAC Level2 (higher thematic depth)
  - LEAC Level1
- Urban Vegetation Layer 2013
  - low and high vegetation
  - minimum mapping unit 0,1ha
  - significant single trees
- Statistics, Maps & Presentations

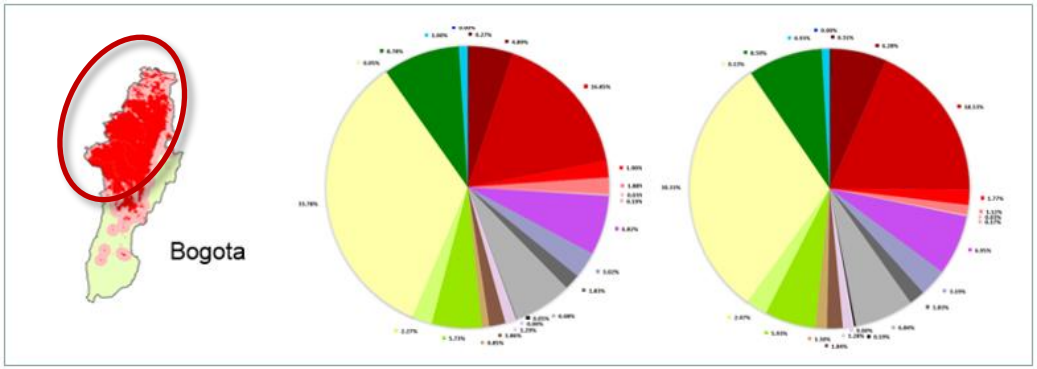


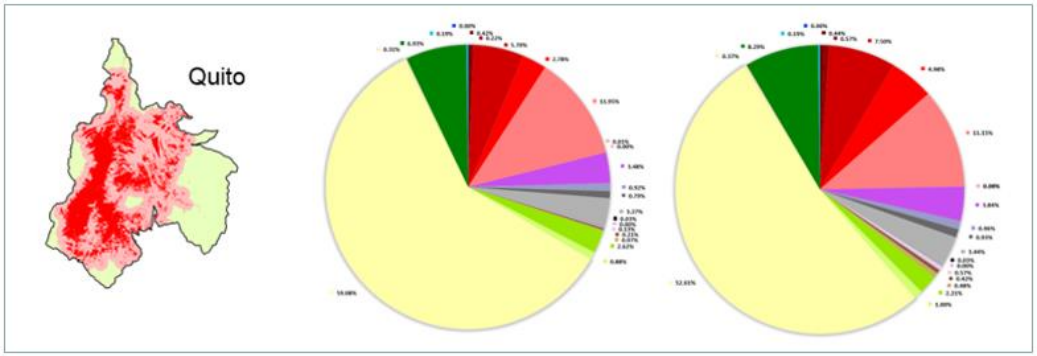
The EO Products: What They Are

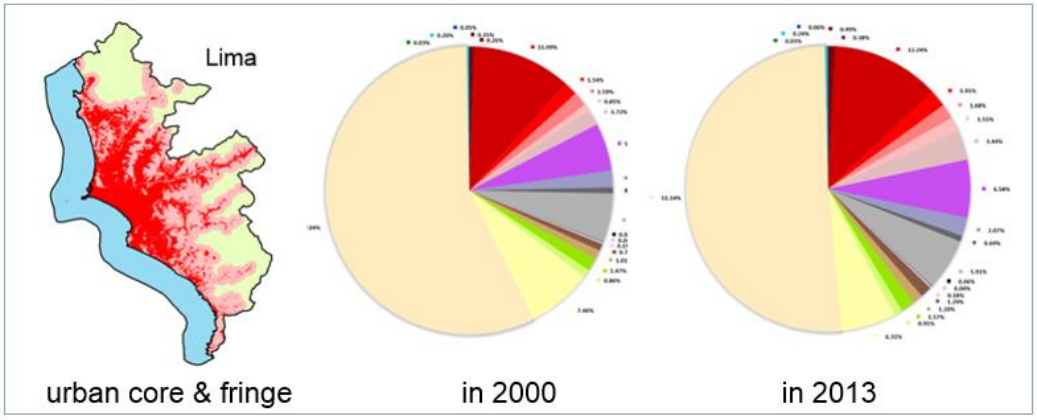
- EO data used
  - 2000: SPOT 4/5 (2,5m … 5m)
  - 2000: Landsat 7 (15m)
  - 2013: SPOT 5/6 (1,5 – 2,5m)
  - *2015: Sentinel 2 (10m resolution)*
- Data – easy to handle
  - different exchange formats (shp)
  - conform to PUMA platform
- Google-ready
  for a wider audience
  (kml)



Comparability of Metropolitan regions







Urban Atlas

- 1.1.1.1. - Continuous dense urban fabric
- 1.1.1.2. - Continuous medium dense urban fabric
- 1.1.2.1. - Discontinuous dense urban fabric
- 1.1.2.2. - Discontinuous medium dense urban fabric
- 1.1.2.3. - Discontinuous sparse urban fabric
- 1.1.3. - Informal transition
- 1.1.4. - Informal settlement
- 1.2.1. - Industrial and Commercial
- 1.2.1.3. - Public and Private
- 1.2.2.1. - Fast transit road
- 1.2.2.2. - Other road
- 1.2.2.3. - Railway
- 1.2.3. - Port area
- 1.2.4. - Airport
- 1.3.1. - Mineral extraction and dump site
- 1.3.3. - Construction sites
- 1.4.1. - Green urban areas
- 1.4.2. - Sports and leisure facilities
- 2.1. - Acriculture and natural vegetation
- 2.2. - Bare ground
- 3. - Forest
- 5.1. - Inland water
- 5.2. - Marine water

comparable due to

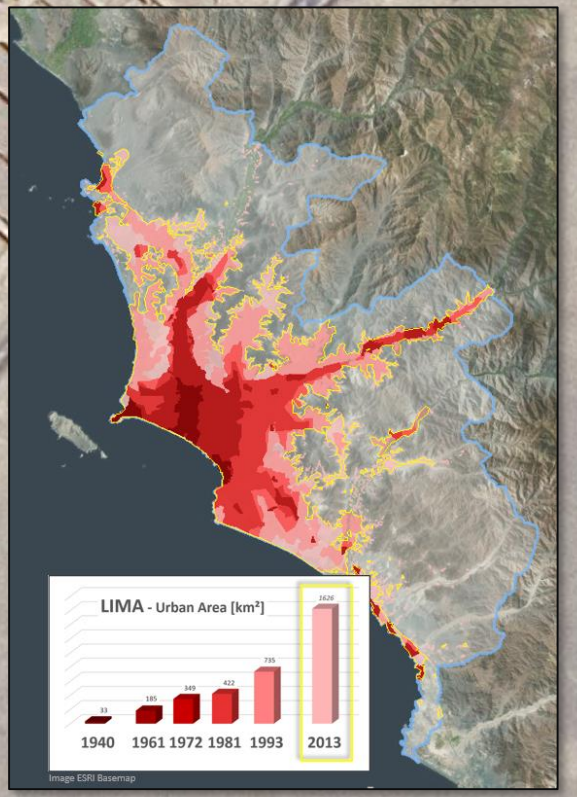
- similar dates
- similar nomenclature Urban Atlas (applied standard)
- easy to combine with other sources
- administrative units

limitations

- subset definition → often related to administrative units

- Suggestion:
  core area & buffer approach, considering administrative units

Lima – Urban spreading (“informal transition”)



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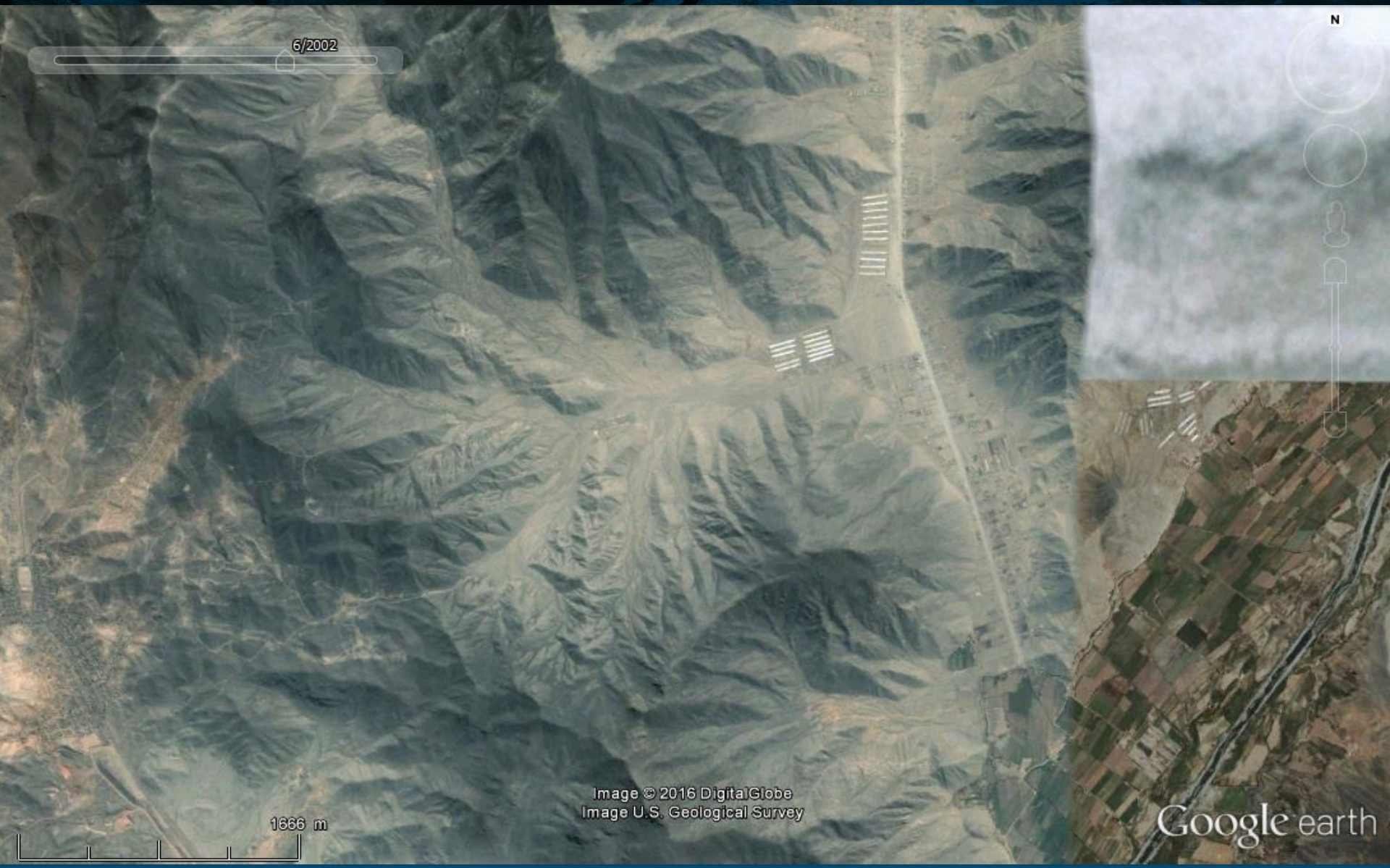
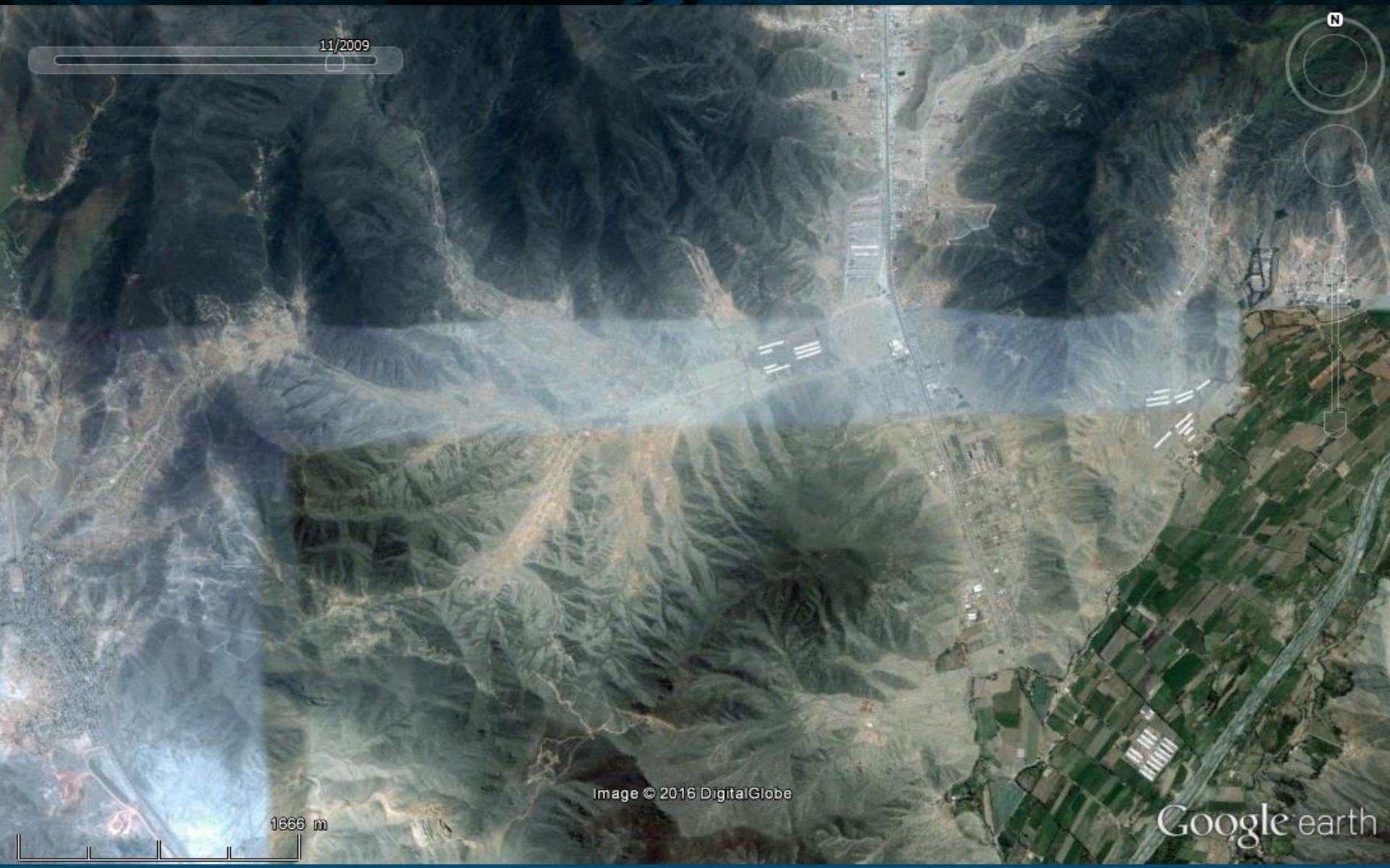


2002 2009 2013 2015

Lima – Urban spreading ("informal transition")



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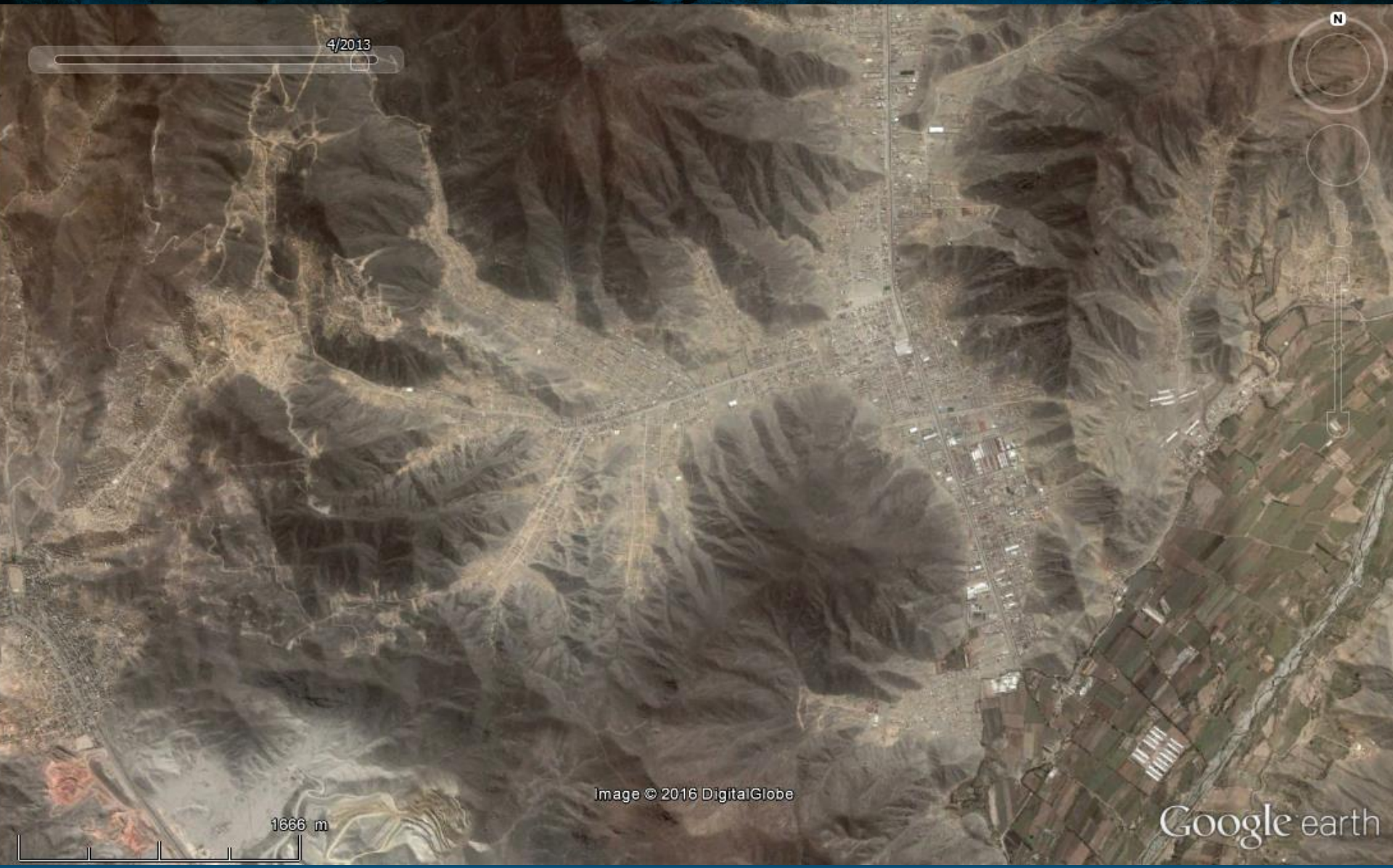

2002 2009 2013 2015

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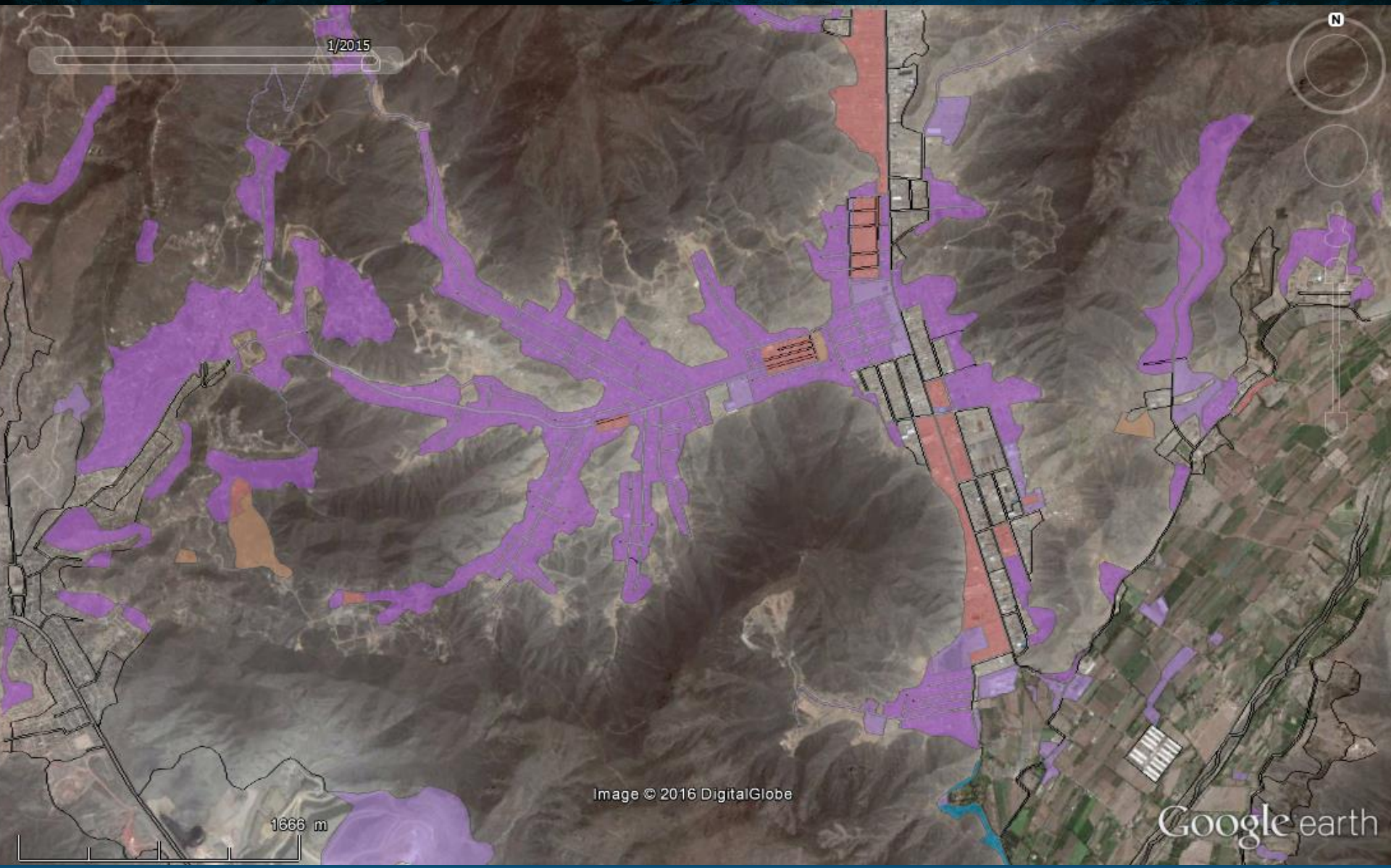

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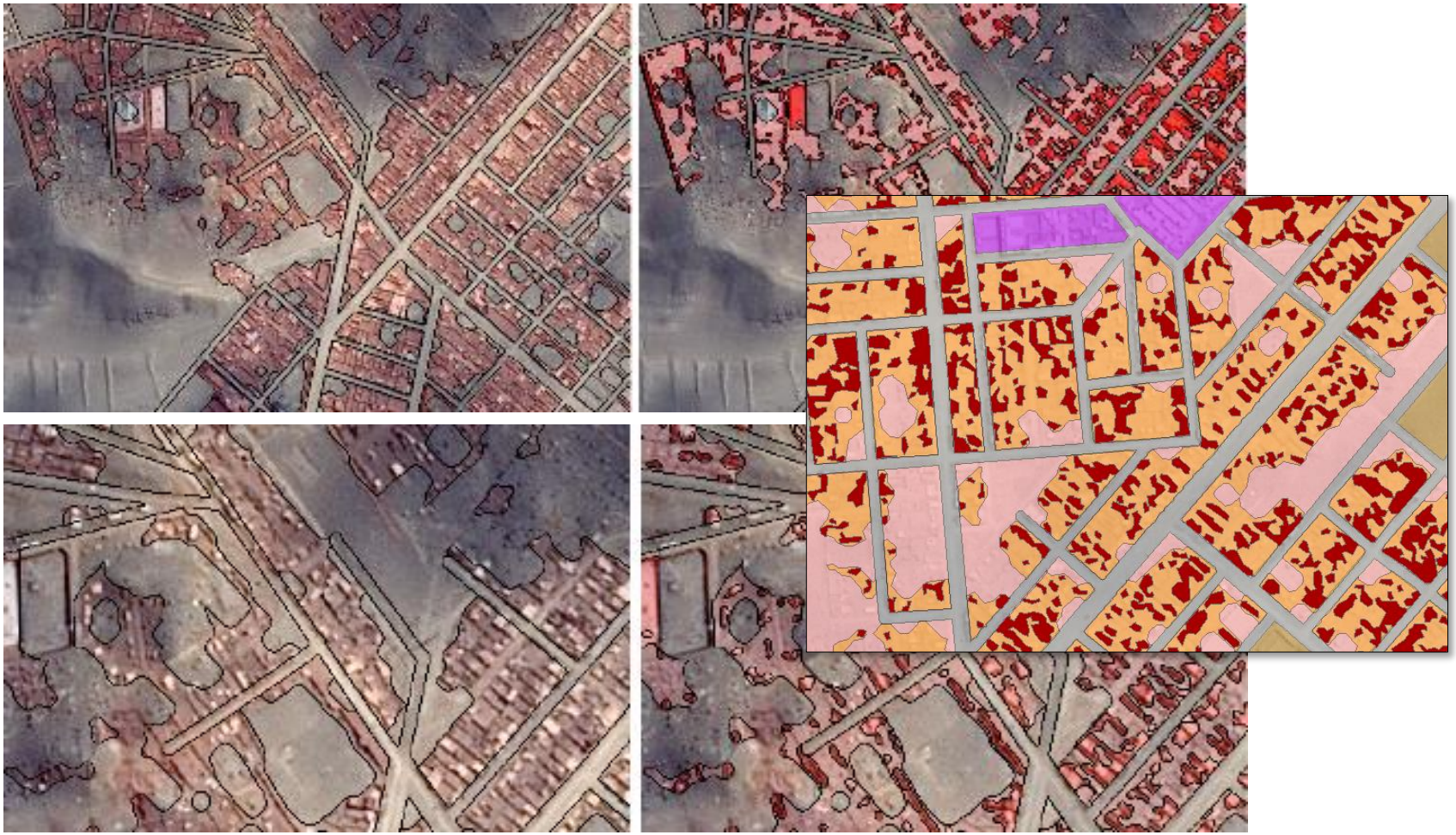
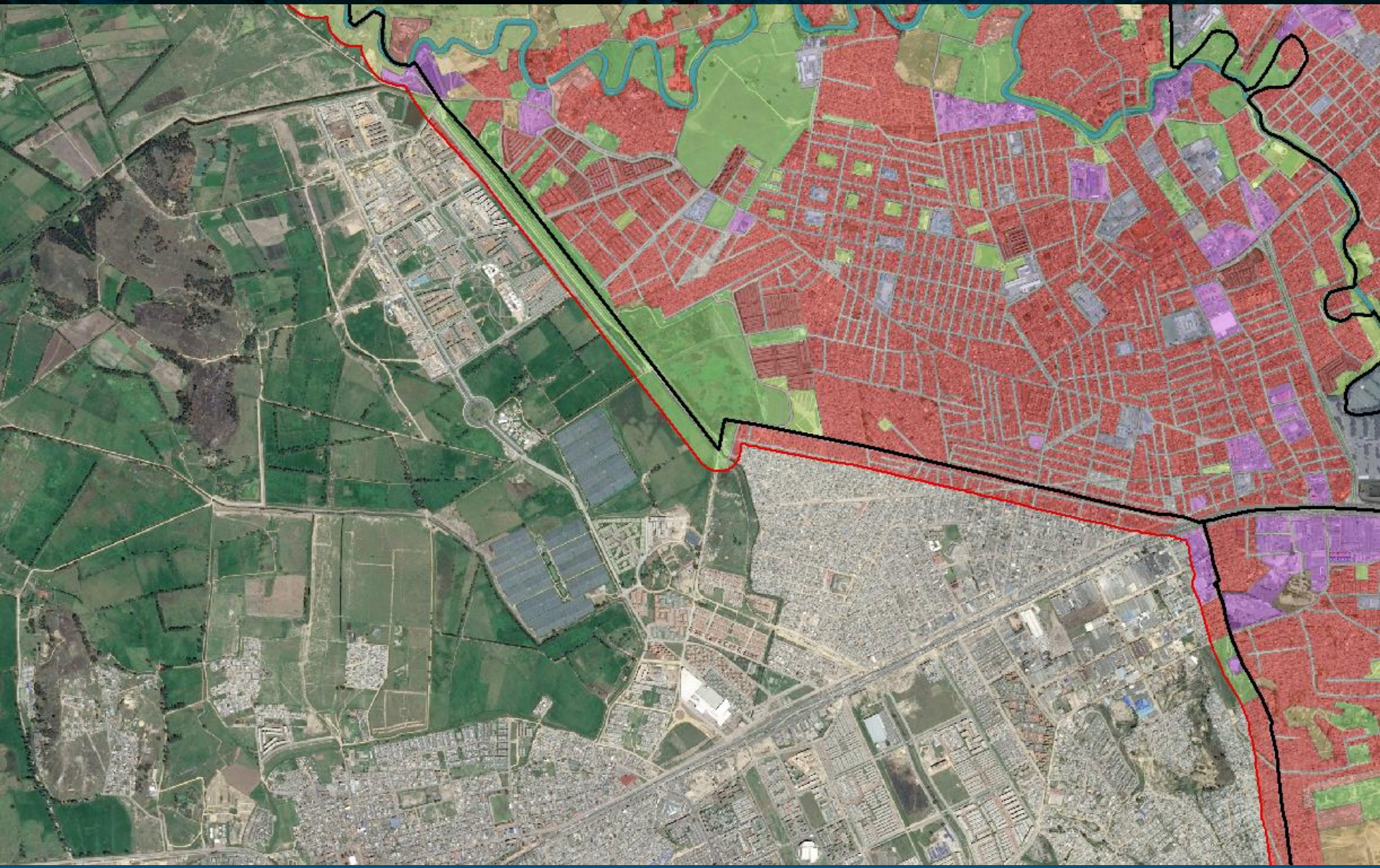


- detecting populated areas and open spaces in-between, density, & avg. size of housing
- fast, comparable and repeatable at reasonable quality

Quito – Urban Vegetation

Urban Vegetation Layer

Bogota – Urban Area ⇔ Area with significant change



Bogota – Urban Area ⇔ Area with significant change

example Bogota

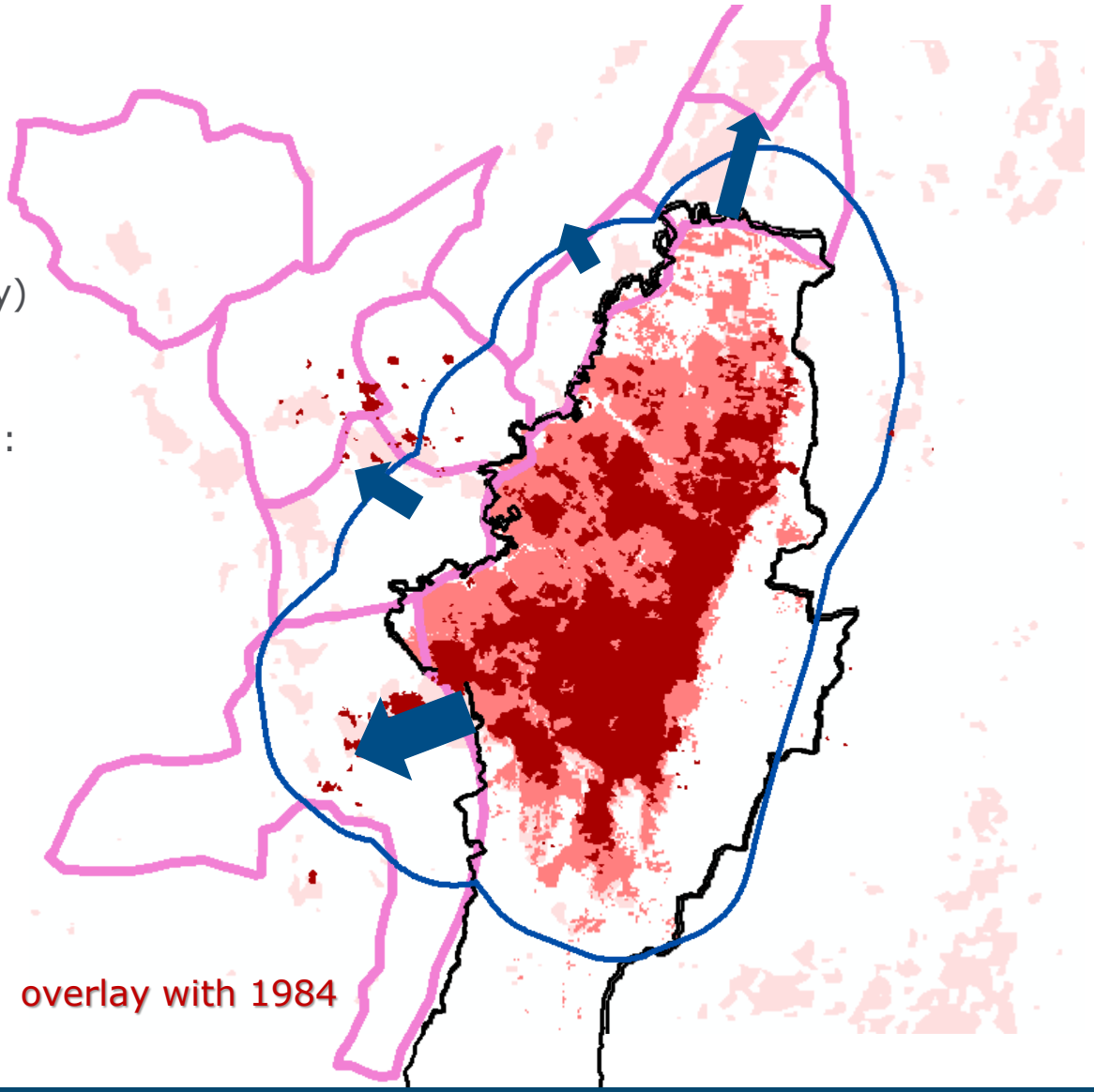
- urban core
  (up-to-date, draft classification)
- EOworld2 subset for mapping
  Mapping result 2013 (Urban only)

- calculation of buffer area
  (relative to absolute size of city):

$$r(buffer) = 0{,}25\sqrt{A(core)}$$

+ administrative Units:

map & analyse areas
under severe change



overlay with 1984

Summary: The EO Products – What They Bring

POTENTIAL INPUT

.. to save World Bank costs

+ World Bank references

GIS,
previous analysis layer

+ auxiliary data

land use,
thematic features

+ in-situ knowledge

hot-spots,
special aspects of the cities

+ local contact

CONTEXT OF USE?

providing solutions for
simplification & optimization processes

URBAN SERVICE LAYER RANGE

GOALS & CHALLENGES OF ANALYSIS?

FEEDBACK INFO (BENEFITS)

high level of detail

- urban density classes
- comparable (date, legend)
- high accuracy

back- & up-dating

geographically extendable

- Sentinel 2 ?

downstream services

terrain, risk … ?

fast results

independent

- large area
- low data & mapping costs: regional mapping level
- cost aspects can be reduced by automation (reasonable quality)

Your Contact

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