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Tools and Services for the Humanitarian Community for Groundwater Exploration and Water Management
Who is Z_GIS?

Interfaculty Department of Geoinformatics – Z_GIS

- Quality of Life and Smart Mobility
- Environment and Resource Efficiency
- Risk and Social Vulnerability
- Humanitarian Action and Human Security
Mission:
Provide Earth-Observation based geospatial information products to humanitarian actors

Constraints:
- Difficult security situation on the ground
  - Limited time frame
- Limited knowledge about region
- Decision makers are not experts

What can remote sensing do to help?
(it should be the perfect tool, right?)
Mission:
Provide Earth-Observation based geospatial information products to humanitarian actors
Mission:
Provide Earth-Observation based geospatial information products to humanitarian actors

25 countries, 350+ maps provided since 2011

Mostly population maps of refugee camps and settlements; also towns, landcover
Information products related to water to support:

- groundwater exploration
- Installation /construction of infrastructure
- Water management

Always key issue:

We can’t see everything from above. Integration of existing information, field knowledge and remote sensing analysis is essential.
EO-based services for water: Groundwater exploration

Digital Elevation Model → Satellite Imagery → Satellite-derived geological map → Hydrogeological Reconnaissance Map → Road network

available geological maps + Expert evaluation

SEE NEXT TALK BY GERAINT BURROWS, GROUNDWATER RELIEF!
EO-based services for water: Installation of Infrastructure

- Nepal: Reconstruction of water pipelines in Lapilang, Nepal
- Cooperation with Austrian Red Cross

Where is the water needed?

→ Mapping of buildings in VHR images + local survey
Where to place communal water taps?
Requirements: Maximum distance 150 m horizontal, 50 m vertical

→ DEM from Spot 6 (2 m spatial resolution), spatial analysis
EO-based services for water:
Installation of Infrastructure

Where to place communal water taps?

Requirements:
- Maximum distance: 150 m horizontal, 50 m vertical

- DEM from Spot 6 (2 m spatial resolution), spatial analysis
EO-based services for water: Installation of Infrastructure

Where to build the pipelines from springs to taps?

→ DEM from Spot 6 (2 m spatial resolution), longitudinal sections
EO-based services for water: Installation of Infrastructure

Where to place communal water taps? Requirements: Maximum distance 150 m horizontal, 50 m vertical.

DEM from Spot 6 (2 m spatial resolution), spatial analysis.
EO-based services for water: Installation of Infrastructure

Are the sources safe against pollution?

→ Land use/land cover mapping of catchment areas
EO-based services for water: Installation of Infrastructure

Road and buildings (stables/toilets?) only 50 m upstream of source
Development of tools
(generic, but applicable to water)
Multi-purpose technology to exploit Big Earth Data: Applications for Water Management

1. Optical satellite image data and associated fully automatic data derived information layers
   - Data-derived EO Level 2 categorical and semantic variable at time T-x
     = Scene classification map (SCM)
   - Data-derived EO Level 2 numeric variable(s) at time T-x, e.g., class-conditional spectral index(es)

2. Array database system storing images and image derived products for fast querying

3. Semantic content-based queries through time and space in user defined AOIs by a graphics inference engine

Service architecture

Application independent re-usable Big EO data approach

Situation (conflict/crisis) specific domain expert based indicator extraction through time

1. Pre-classifications
   Fully automatic, data-derived geospatial information layers

2. Array-DBMS (Database Management System)
   - Storage using array model
   - Multidimensional array as data model. Each cell can contain one or more values.
   - Declarative query language (Slicing, Dicing, Aggregation, ...).
   - Tiling supports range queries, optimised physical data access.

3. Graphical inference engine
   - Spatiotemporal Semantic Queries / Information extraction through time
   - Graphical User Interface

   World-knowledge transfer
   from humans to the machine
   Knowledge engineer, Human domain expert

Answer (OGC conform georeferenced analysis products as input for additional integrated analyses, data integration and/or cartographic map production)
Application example: Mapping of irrigated agriculture, border region Turkey- Syria

- Comparison August 2010 – August 2014
- Relevant for water management
- The **generic approach** to extract such indicators allows repetition **on-the fly** for different time intervals

Application example: Ex-post flood extent mapping in Somalia, from Big Earth Data

- The example is based on a dense temporal stack of 78 Landsat 8 scenes
- Generic approach
- Optimized database use → very little time of operator needed

Humanitarian Services at Z_GIS:

EO-based information services, proven and available on short notice

New services

Collection and development of innovative technologies and applications

User needs
Let's be a little bit provocative:

Remote sensing for water:
Should make life easier, but requires (at the moment) experts and/or field data for calculation of:
- Precipitation
- Evapotranspiration
- Run-off modelling
- Infiltration and permeability
- Storage of volumes in lakes...

Solutions?

1. Tools become really simple and clear
2. We team up.
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