UNIVERSITÄT SALZBURG

Land@Slide

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Communicating Earth Observation (EO)-based landslide mapping capabilities to practitioners

EGU 2016, Vienna, 18.04.2016

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Z GIS

GRID-IT

Geologische Bundesanstalt

FFG

bmvit Bundesministerium für Verkehr, Innovation und Technologie

Land@Slide

EO-BASED LANDSLIDE MAPPING

From methodological developments to automated web-based information delivery

UNIVERSITÄT SALZBURG Z_GIS

FFG

Abstract

Communicating Earth Observation (EO)-based landslide mapping capabilities to practitioners

Florian Albrecht, Daniel Hölbling, Clemens Eisank, Elisabeth Weinke, Filippo Vecchiotti, and Arben Kociu

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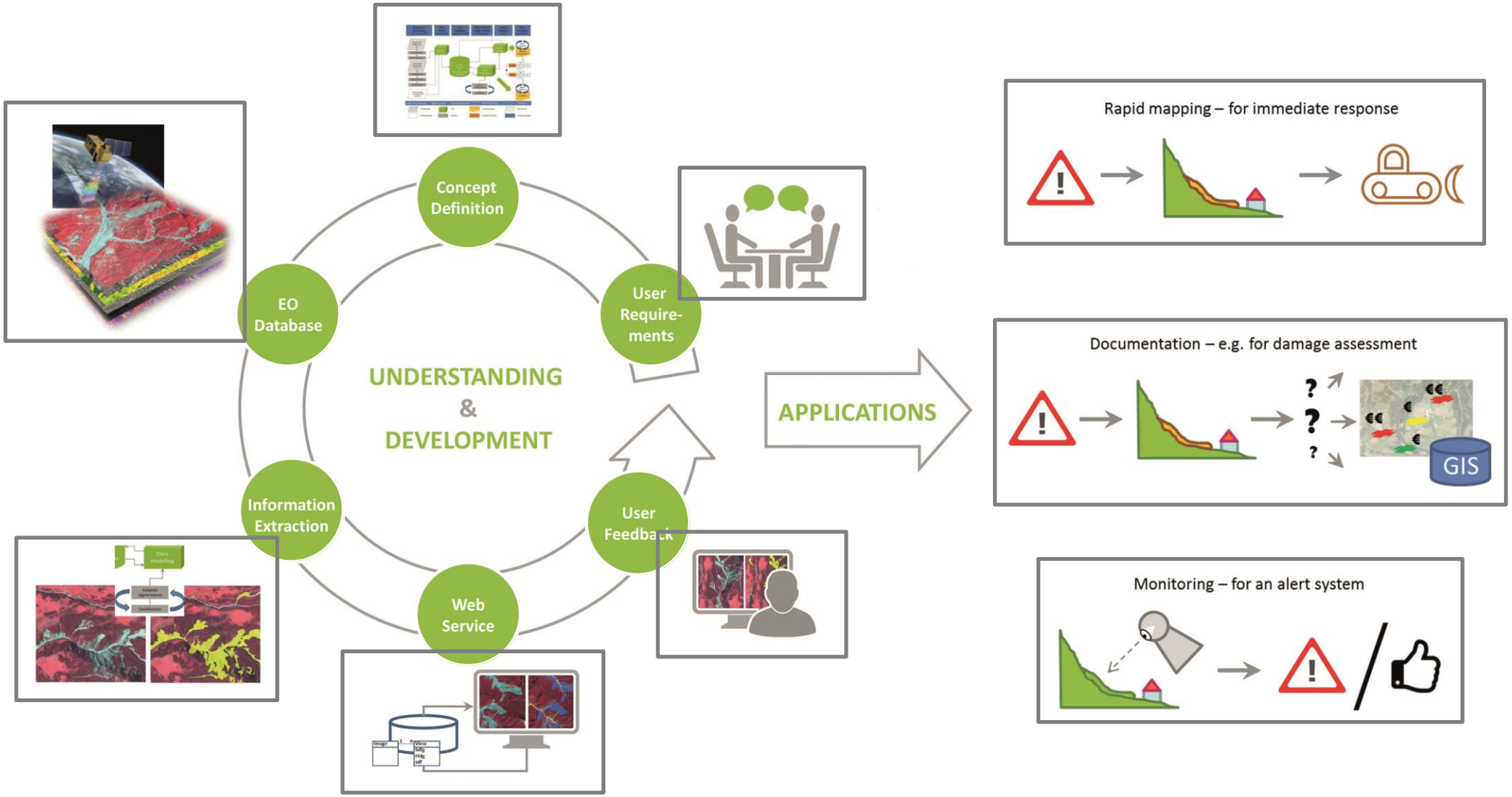

Project Team:

Interfaculty Department of Geoinformatics – Z_GIS, University of Salzburg, Austria

GRID-IT – Gesellschaft für angewandtze Geoinformatik mbH, Austria

Geologische Bundesanstalt (GBA), FA Ingenieurgeologie, Austria

Project Duration:
March 2015 – August 2017

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Website: http://landslide.sbg.ac.at

Funding:
Austrian Research Promotion Agency (FFG)
Austrian Space Applications Programme (ASAP)

Abstract

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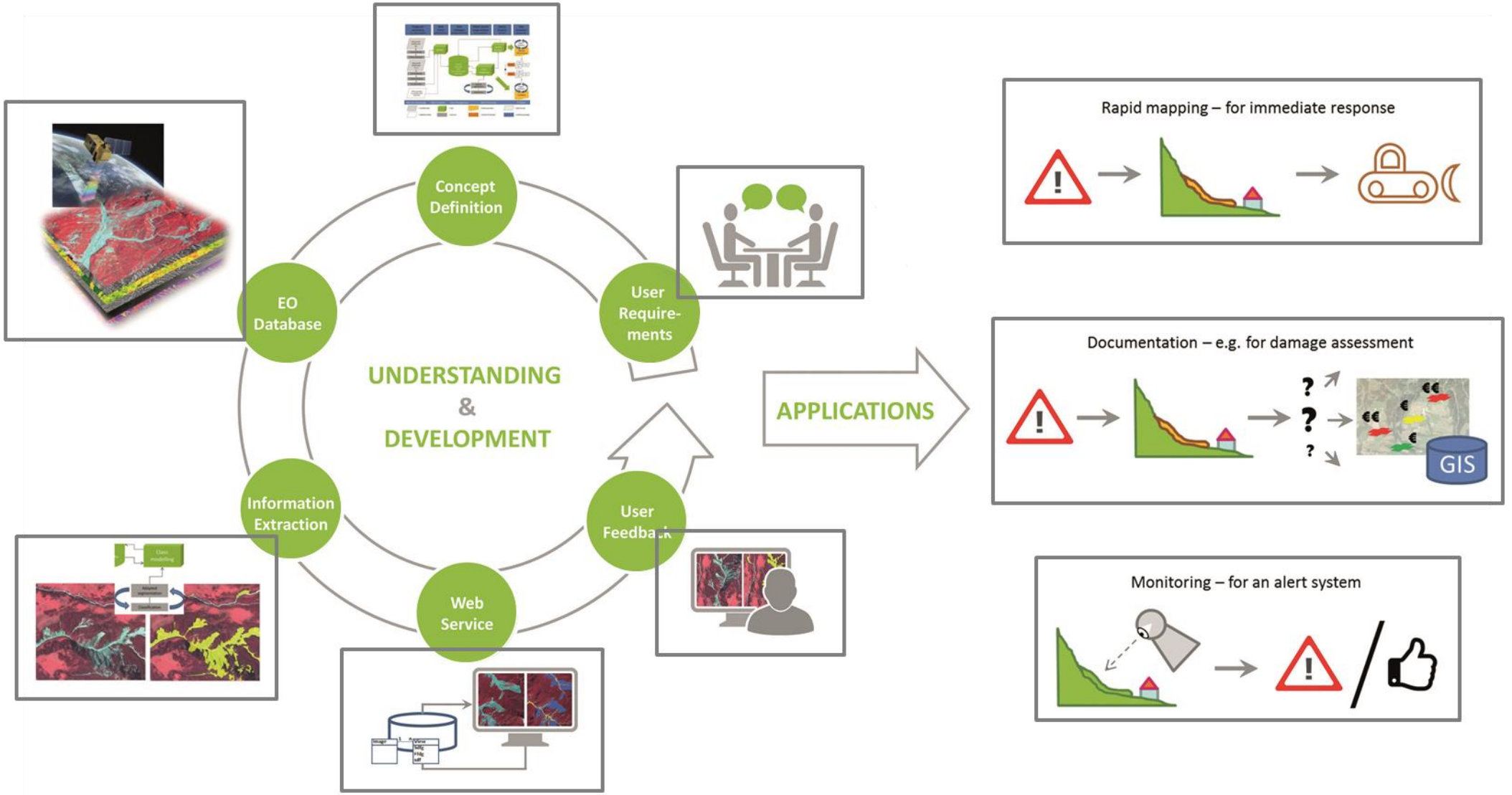

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Communicating Earth Observation (EO)-based landslide mapping capabilities to practitioners

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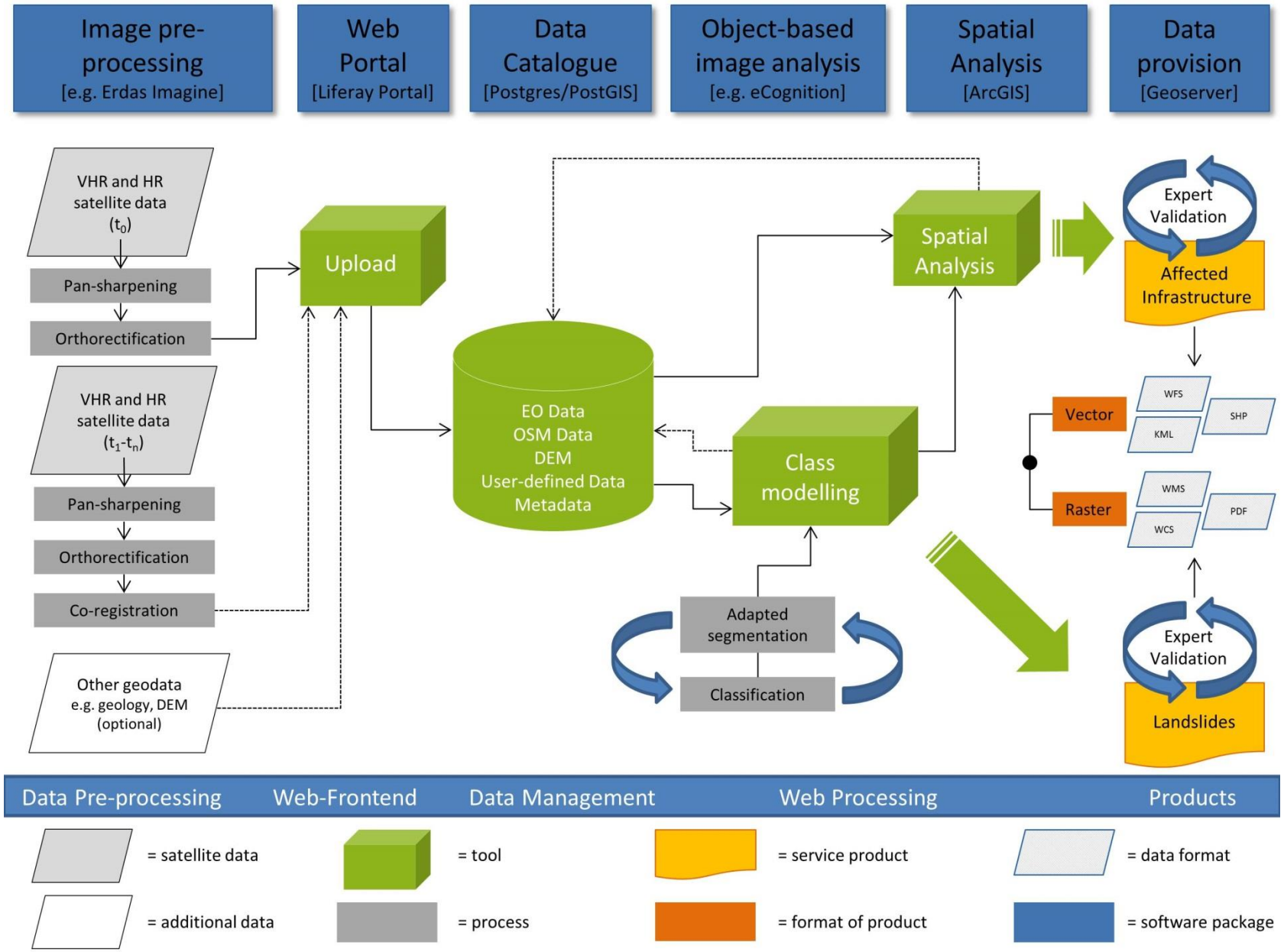
Current remote sensing methods and the available Earth Observation (EO) data for landslide mapping already can support practitioners in their processes for gathering and for using landslide information. Information derived from EO data can support emergency services and authorities in rapid mapping after landslide-triggering events, in landslide monitoring and can serve as a relevant basis for hazard and risk mapping. These applications also concern owners, maintainers and insurers of infrastructure. Most often practitioners have a rough overview of the potential and limits of EO-based methods for landslide mapping. However, semi-automated image analysis techniques are still rarely used in practice. This limits the opportunity for user feedback, which would contribute to improve the methods for delivering fully adequate results in terms of accuracy, applicability and reliability. Moreover, practitioners miss information on the best way of integrating the methods in their daily processes. Practitioners require easy-to-grasp interfaces for testing new methods, which in turn would provide researchers with valuable user feedback.

We introduce ongoing work towards an innovative web service which will allow for fast and efficient provision of EO-based landslide information products and that supports online processing. We investigate the applicability of various very high resolution (VHR), e.g. WorldView-2/3, Pleiades, and high resolution (HR), e.g. Landsat, Sentinel-2, optical EO data for semi-automated mapping based on object-based image analysis (OBIA). The methods, i.e. knowledge-based and statistical OBIA routines, are evaluated regarding their suitability for inclusion in a web service that is easy to use with the least amount of necessary training. The pre-operational web service will be implemented for selected study areas in the Alps (Austria, Italy), where weather-induced landslides have happened in the past. We will test the service on its usability together with potential users from the Geological Survey of Austria (GBA), various geological services of provinces of Austria, Germany and Italy, the Austrian Service for Torrent and Avalanche Control (WLV), the Austrian Federal Forestry Office (ÖBf), the Austrian Mountaineering Club (ÖAV) and infrastructure owners like the Austrian Road Maintenance Agency (ASFINAG). The results will show how EO-based landslide information products can be made accessible to responsible authorities in an innovative and easy manner and how new analysis methods can be promoted among a broad audience. Thus, the communication and knowledge exchange between researchers, the public, stakeholders and practitioners can be improved.

Back

Concept Definition

Preliminary architecture of an EO-based landslide information web service



The pre-operational service relies on a database of high resolution and very high resolution optical EO data from various sensors.

Semi-automated mapping routines that are adaptable to changing EO data and geographical settings enable the identification of landslides.

A web service gives access to EO data and integrates the mapping routines via a web processing chain. The user is able to map landslides and to identify landslide-affected infrastructure.

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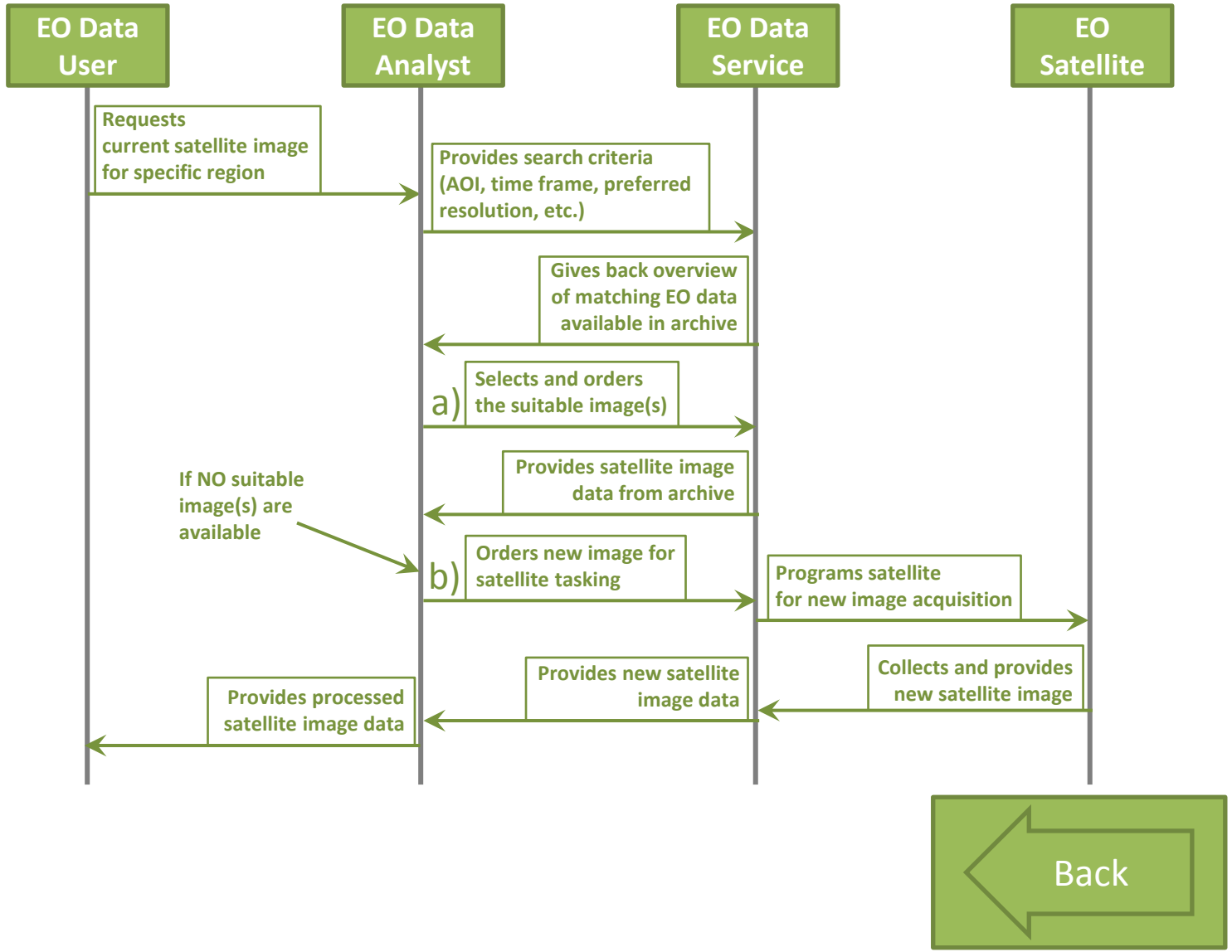
Satellites

- High Resolution
  - Landsat
  - SPOT 4/5
  - Sentinel-2
  - Rapideye
- Very High Resolution
  - Quickbird
  - Worldview 2/3
  - GeoEye-1

Other

- DEM data
- Etc.

Searching and tasking EO satellite data



Quickbird-2

Location: Haunsberg, Salzburg, Austria
Date: 28.04.2002

Resolution: 0.6m (pan), 2.4 (ms)
Bands: blue, green, red, infrared

Availability: commercial
Operator: DigialGlobe
Reseller: European Space Imaging

Online Archive:
http://iohs.euspaceimaging.com/smartsearch

Switch to Landsat-7

0
250
500 m

Back

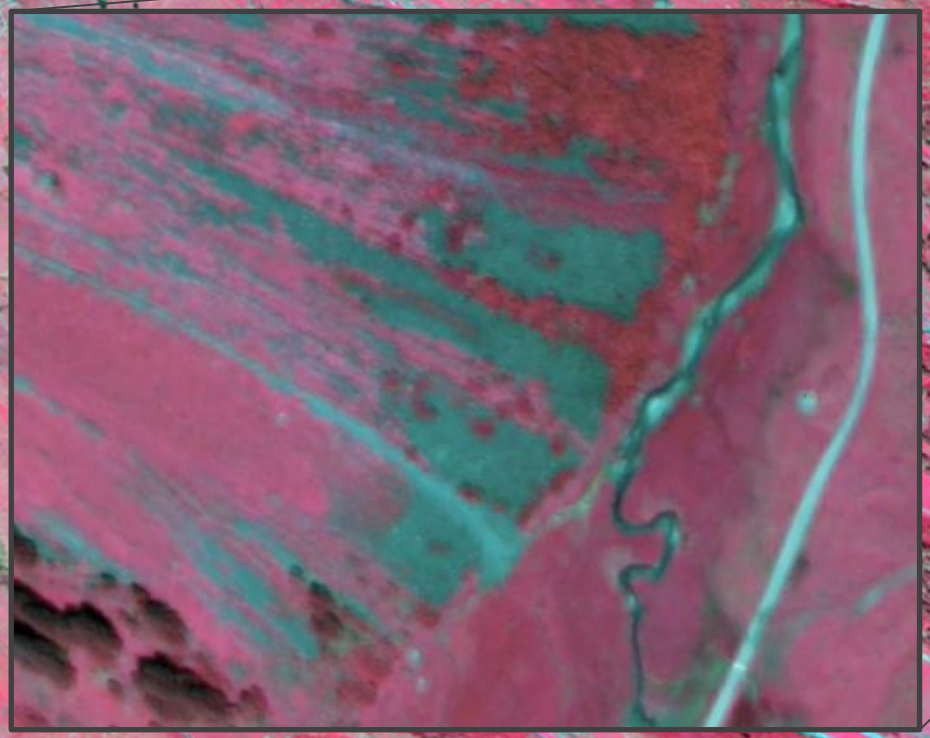
GeoEye-1

Location: Montafon, Vorarlberg, Austria
Date: 05.08.2015

Resolution: 0.5m (pan), 2.0 (ms)
Bands: blue, green, red, infrared

Availability: commercial
Operator: DigialGlobe
Reseller: European Space Imaging

Online Archive:
http://iohs.euspaceimaging.com/smartsearch



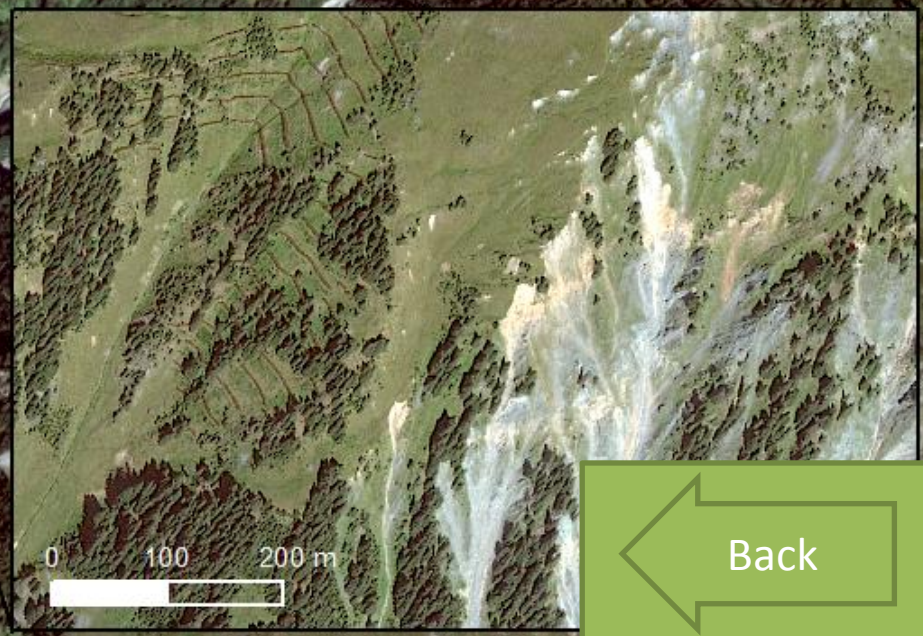
Back

WorldView-2

Location: Montafon, Vorarlberg, Austria
Date: 29.08.2015

Resolution: 0.5m (pan), 2.0 (ms)
Bands: blue, green, red, infrared

Availability: commercial
Operator: DigialGlobe
Reseller: European Space Imaging
Online Archive:
http://iohs.euspaceimaging.com/smartsearch



0 1 000 2 000 m

Back

Landsat-7

Location: Haunsberg, Salzburg, Austria
Date: 28.07.2002

Resolution: 15m (pan), 30m (ms)
Bands: blue, green, red, infrared, swir1, swir2, tir

Availability: free download
Operator: NASA
Provider: United States Geological Survey

Online Archive:
http://earthexplorer.usgs.gov/

USGS science for a changing world

Switch to Quickbird-2

See also Quickbird-2

0 1.000 2.000 m

Back

Rapideye

Location: Taxenbach, Salzburg, Austria
Date: 06.08.2013

Resolution: 5.0m (ms)
Bands: blue, green, red, red-edge, infrared

Availability: commercial
Operator: BlackBridge

Online Archive:
http://eyefind.rapideye.com/

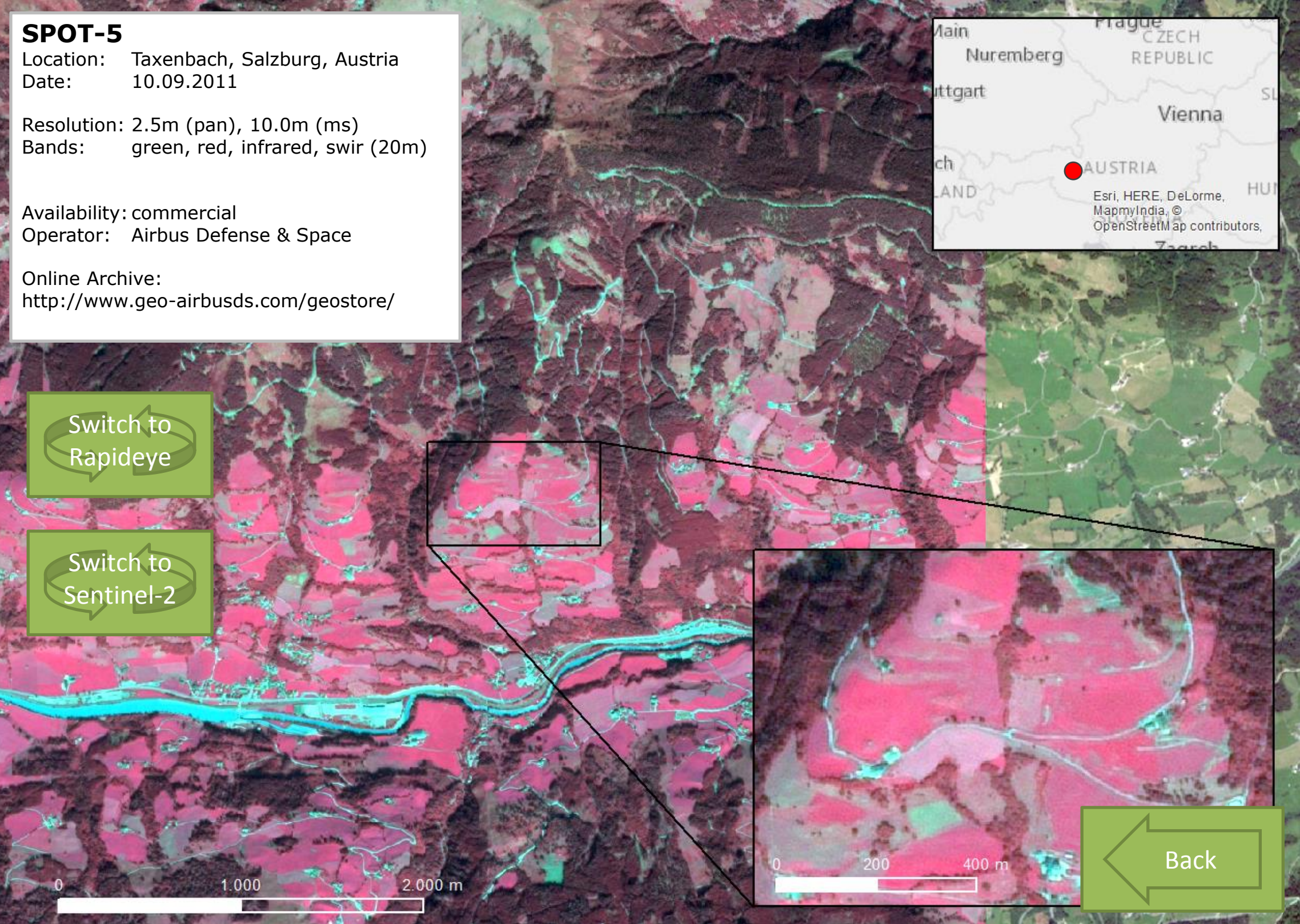
Switch to SPOT

Switch to Sentinel-2

0 1.000 2.000 m

0 200 400 m

Back


SPOT-5
Location: Taxenbach, Salzburg, Austria
Date: 10.09.2011
Resolution: 2.5m (pan), 10.0m (ms)
Bands: green, red, infrared, swir (20m)
Availability: commercial
Operator: Airbus Defense & Space
Online Archive:
http://www.geo-airbusds.com/geostore/
Switch to Rapideye
Switch to Sentinel-2
Nuremberg
CZECH REPUBLIC
Vienna
AUSTRIA
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors,
0
1.000
2.000 m
0
200
400 m
Back

Sentinel-2

Location: Taxenbach, Salzburg, Austria
Date: 18.08.2015

Resolution: 10.0m, 20.0m, 60.0m
Bands: 12 bands, multispectral

Availability: free download
Operator: European Space Agency

Online Archive:
https://scihub.copernicus.eu/

Switch to Rapideye

Switch to SPOT

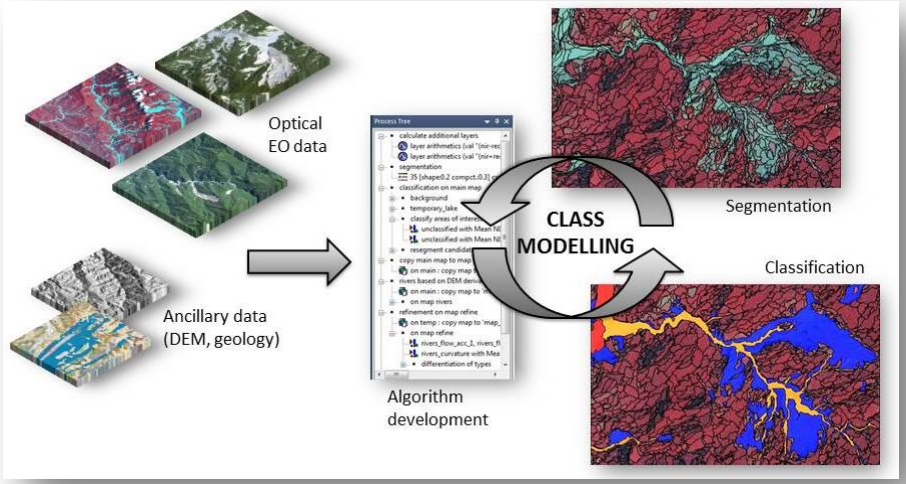
0 1.000 2.000 m

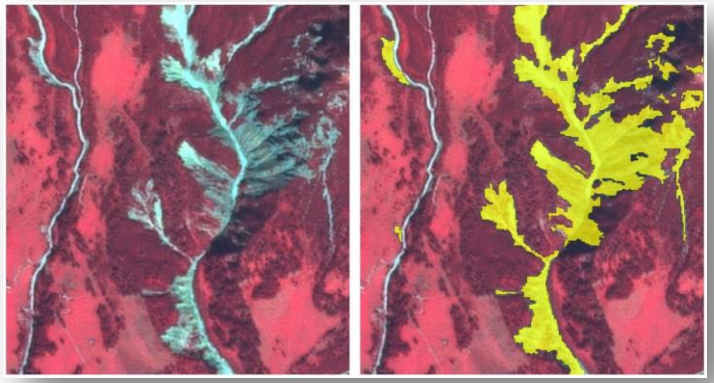
0 200 400 m

Back

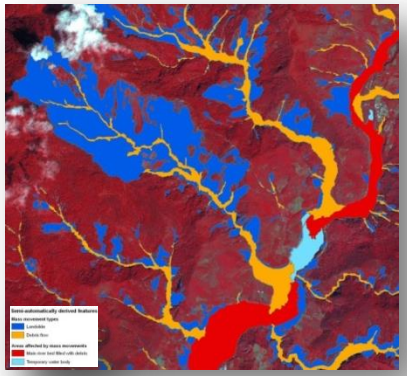
Information Extraction

Getting from raw EO data to landslide information



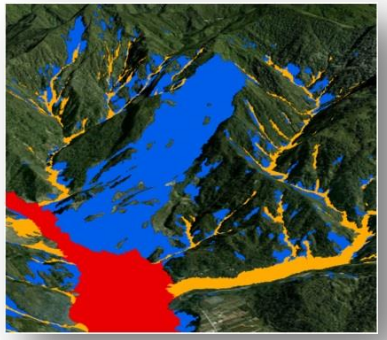


SPOT-5, Austria

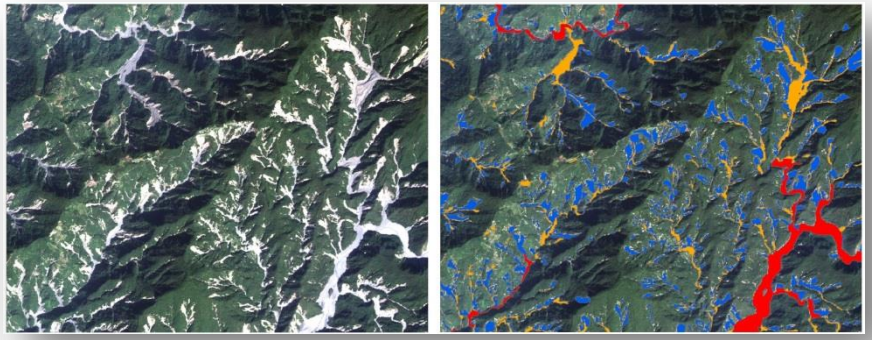


SPOT-5, Taiwan

WV-2, Taiwan



SPOT-5, 3D visualisation
in Google Earth



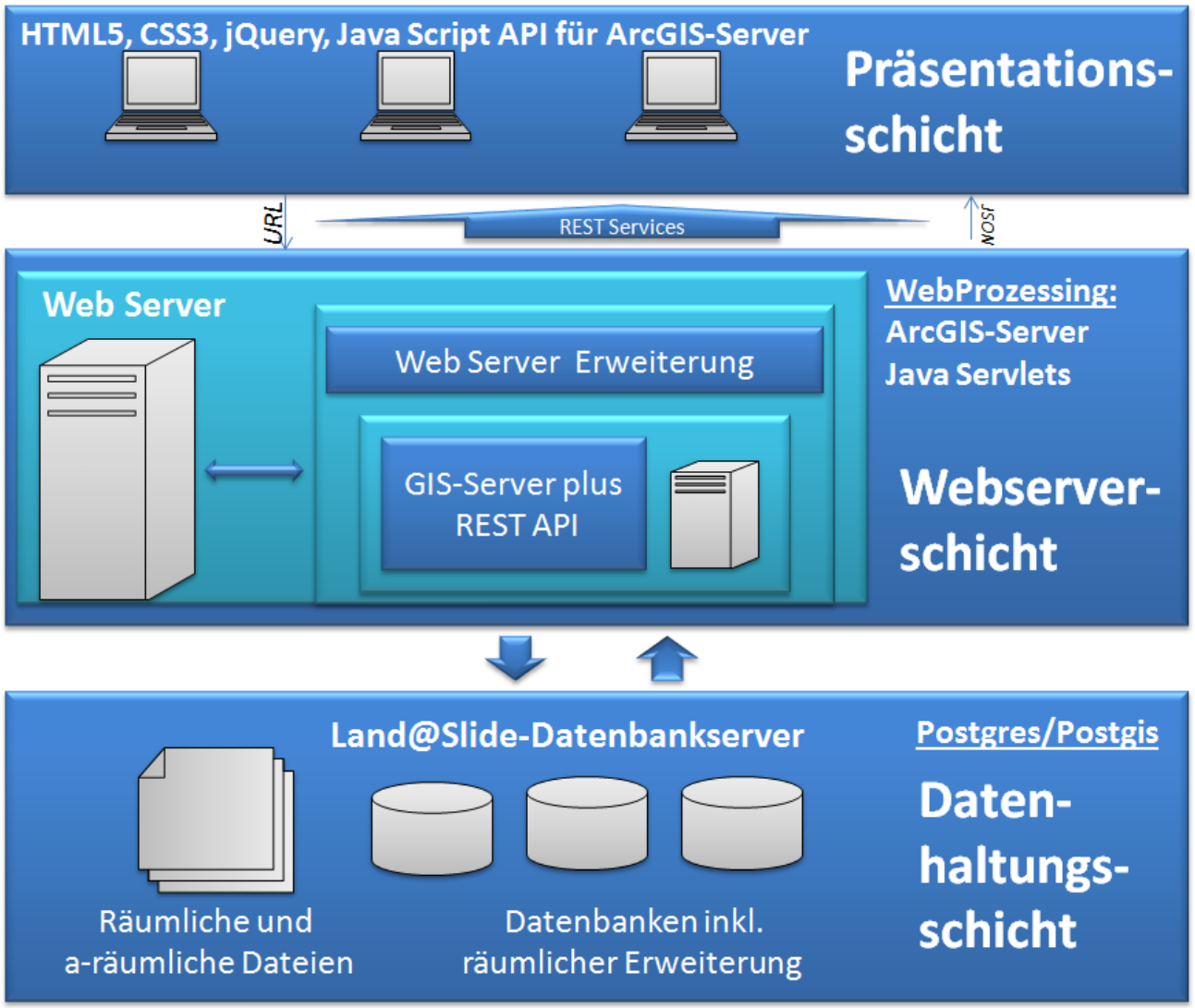
Formosat-2, Taiwan

Back

Semi-automated mapping routines that are adaptable to changing EO data and geographical settings enable the identification of landslides.

Web Service

High level layer structure for implementation



A web service gives access to EO data and integrates the mapping routines via a web processing chain. The user is able to map landslides and to identify landslide-affected infrastructure.

User Interface Layer

A collection of user stories is available that describes the interactions that the user wants to perform with the service, e.g. running a ruleset for landslide information extraction on a satellite image, or displaying extraction results in a map view.

Web Server Layer

The web server hosts the basic functionality of handling geodata, including EO satellite images, and extended functionality for the processing of geodata. Through the user interface layer, it receives the user input for performing processes. It reads and writes the specified data from the database layer.

Database Layer

The database stores all the required data, structured by a comprehensive data model. It includes (but is not limited to) EO data, other geodata, metadata, indices, classification rulsets, etc.

Back

Performed user involvement

- Interviews for user requirements gathering
- Follow-on discussion on preliminary results

Planned further steps of user involvement

- Conduct tests for defined cases
- Perform tests with their own images/data
- Give feedback via an online validation form
- Participate in a validation workshop

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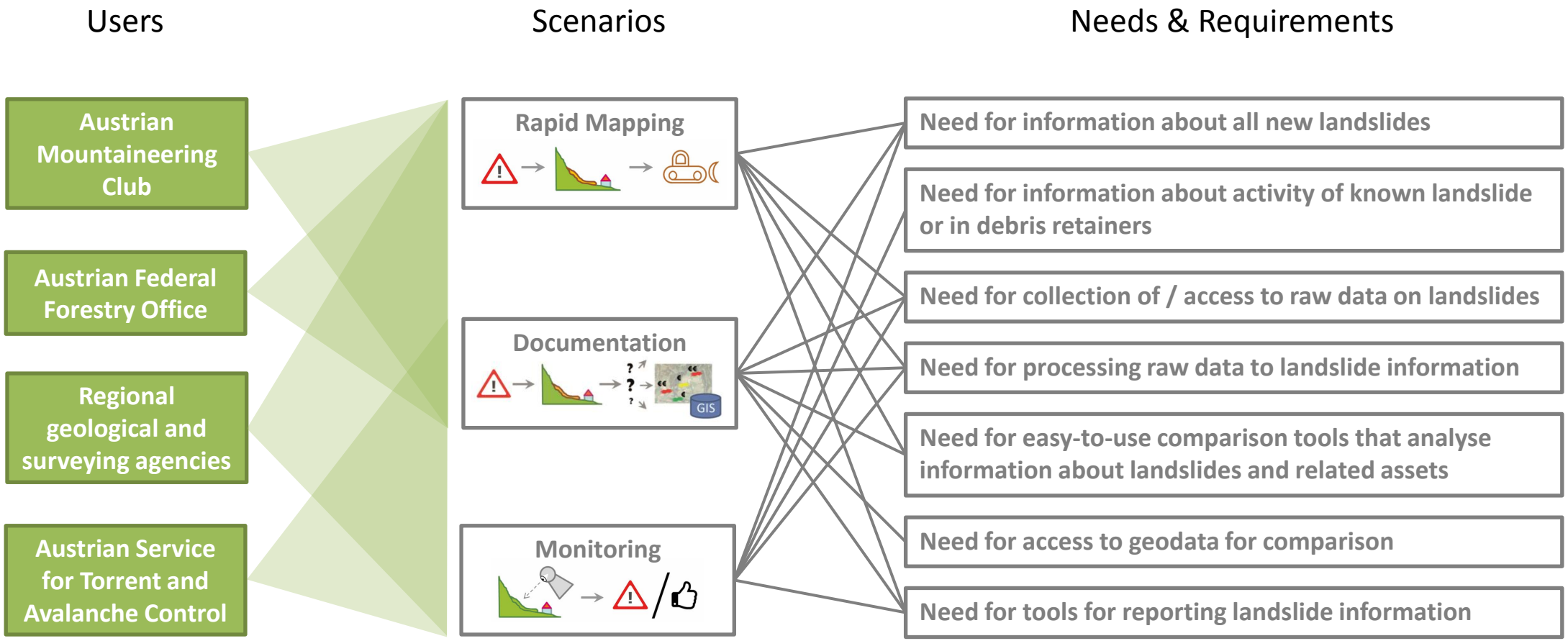
User Requirements

Identified needs of users within their scenarios



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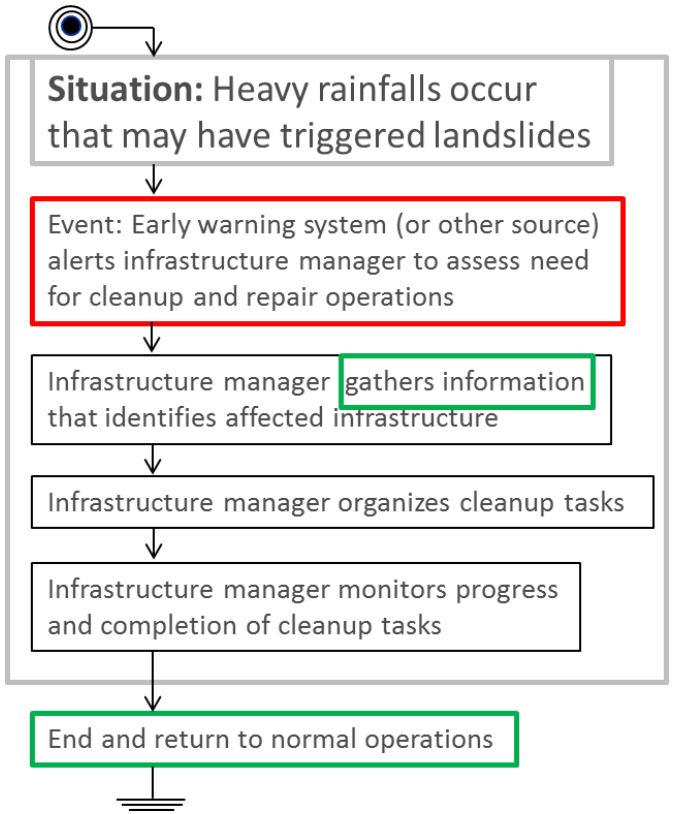
Landslide Rapid Mapping

for immediate response



Specific User Scenarios	Users
Infrastructure damage assessment for planning/coordinating maintenance activities	ÖBF, Austrian Federal Forestry Office; ÖAV, Austrian Alpine Association Geol-Südtirol, Office for Geology and Building Materials Testing of South Tyrol, Italy
Planning emergency and recovery activities	VermVBG, Vorarlberg State Office for Surveying and Geoinformation, Austria Geol-SBG, Geological Agency of the State of Salzburg, Austria
Timely provision of post-event orthophotos	VermVBG; Geol-Südtirol

User's expectation to EO data:

- EO data may help in providing a more comprehensive overview for prioritizing cleanup activities

Selected user requirement – the issue of time

- EO data acquisition and landslide mapping as soon as possible after the event (best case: within 48 hours, if info is not available within 7 days, it has very limited added value; existing reporting workflows provide full information for organizing cleanup within 14 days)

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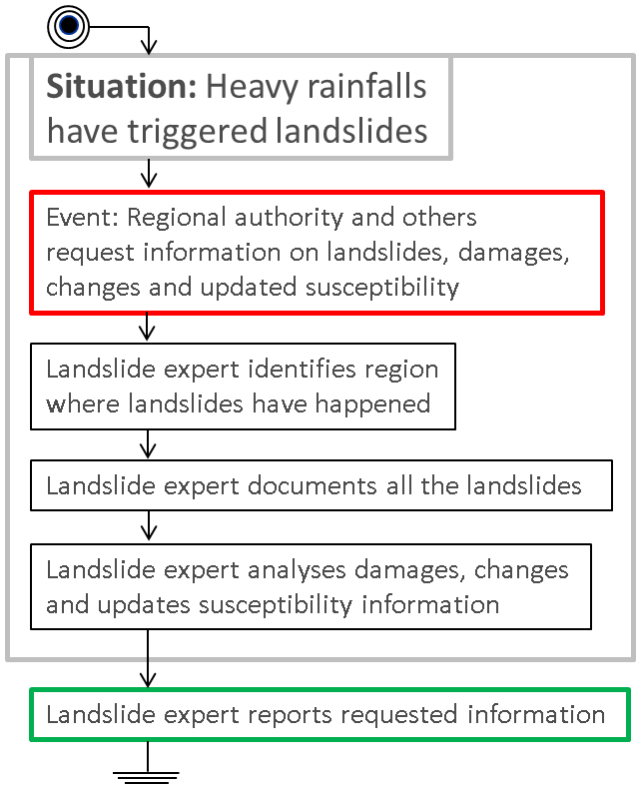
Landslide Documentation and Mapping

e.g. for damage assessment



Specific User Scenarios	Users
Management and planning of infrastructure that is (potentially) affected by landslides, and planning of protective measures	ÖBF, Austrian Federal Forestry Office; Geol-SBG, Geological Agency of the State of Salzburg, Austria, WLV-OÖ, WLV Upper Austria, Austrian Service for Torrent and Avalanche Control,
Management of planning objectives for landslide-affected forestry stands	ÖBF
Update of maps (hiking maps, geological maps)	ÖAV, Austrian Alpine Association Geol-Südtirol , Office for Geology and Building Materials Testing of South Tyrol, Italy
Publish official reports/documentation on major landslide events	VermVBG, Vorarlberg State Office for Surveying and Geoinformation, Austria; Geol-Südtirol; Geol-Bayern, Geological Survey of Bavaria, Bavarian Environment Agency, Germany
Generate/update and share a (standards-conform) regional landslide inventory	Geol-Südtirol, GBA, Geol-Bayern
Landslide susceptibility mapping and establishing an appropriate basis for it	Geol-SBG, WLV-OÖ, GBA

User's expectation to EO data:

- EO data can provide a comprehensive coverage of the mapped region and thereby may improve the completeness of landslide documentation

Selected user requirement – the issue of time

- EO data acquisition as soon as possible after the event (best case: landslides have not yet been cleaned away), landslide information product available within 6 months

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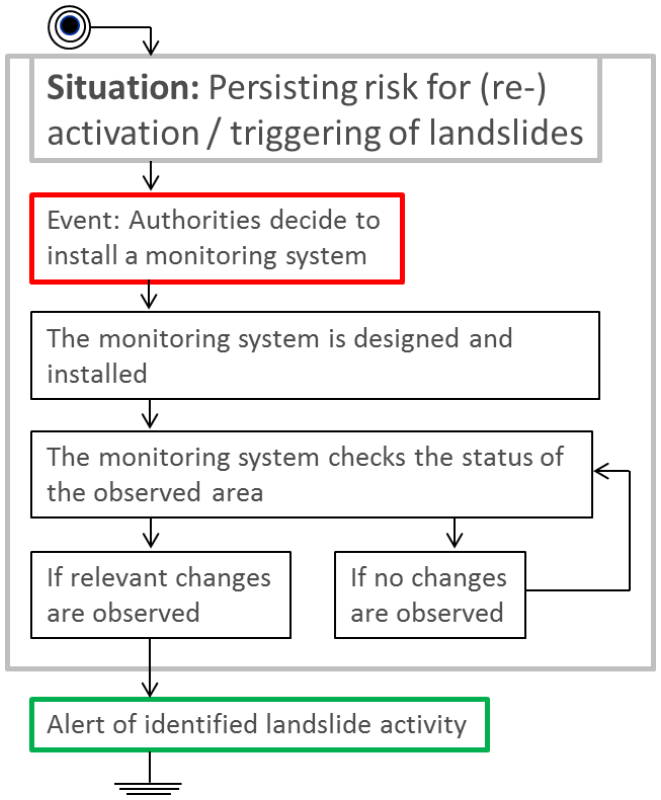
Landslide Monitoring

for an alert system



Specific User Scenarios	Users
Monitoring the status of debris retainers	WLV-OÖ, WLV Upper Austria, Austrian Service for Torrent and Avalanche Control;
Monitoring of slow-moving landslides and reactivated landslides that endanger infrastructure/people	VermVBG, Vorarlberg State Office for Surveying and Geoinformation, Austria; WLV-OÖ; Geol-SBG, Geological Agency of the State of Salzburg, Austria

Opportunity for Sentinel-2

User's expectation to EO data:

- EO data may also be able to identify relevant changes that result in a need for an alert

Selected user requirement – the issue of time

- Identify changes that indicate reactivation of old landslides or indicate new landslides;
  e.g. through regularly repeated EO data acquisition for the identification of changes in surface reflectance

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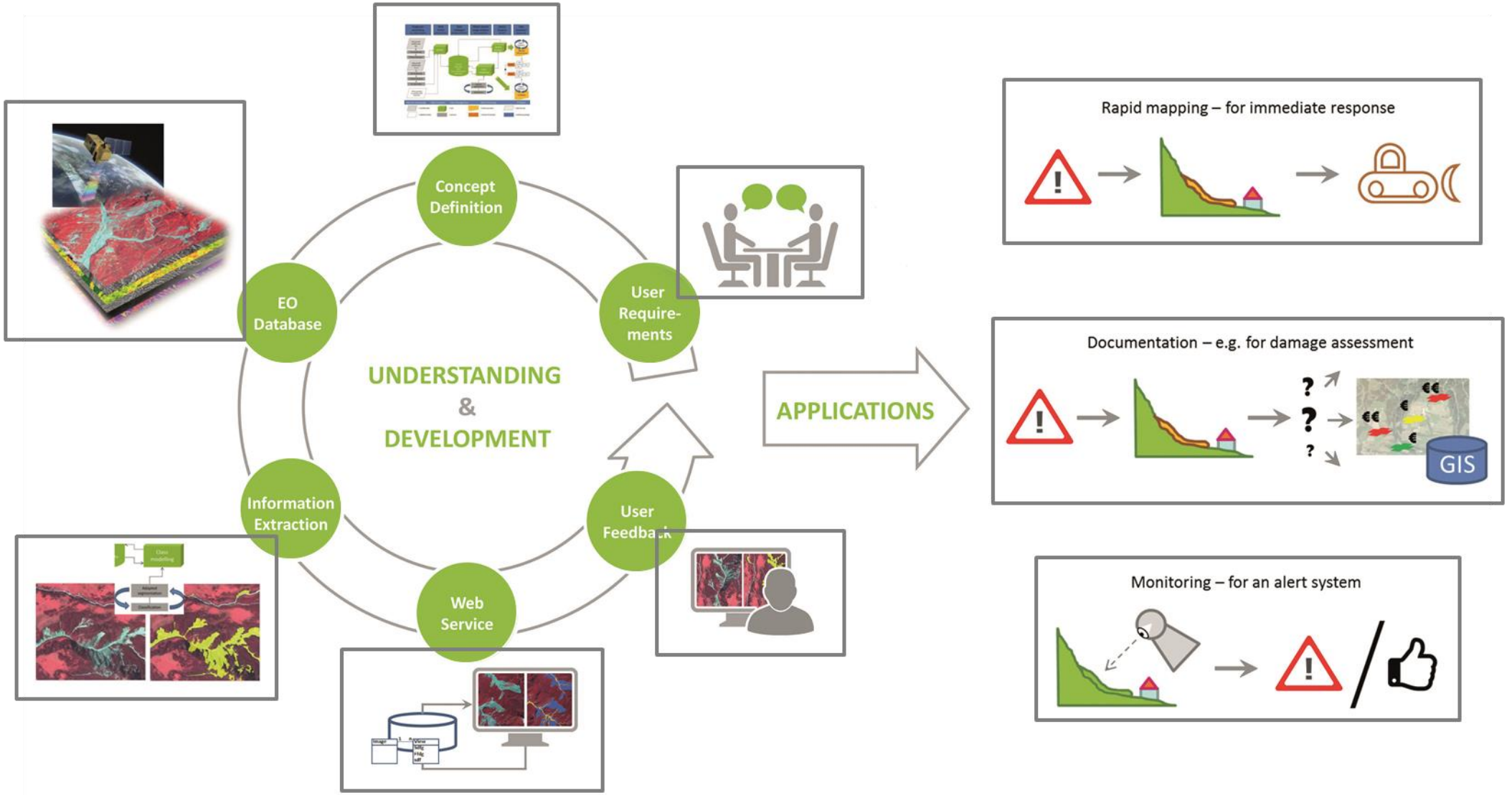

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