Cloud computing for Earth observation

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UL-NTF coordinator
Materials, structure, virtual models/

Research institutions:
UL-FMF
Astrophysics, meteorology

UL-FE
Communication, control, processing

IJS
Electronics ceramics

ZRC-SAZU
Remote sensing

Companies:
DEWESOFT
Telemetry, data acquisition

SINERGISE
GIS applications

TIC LENS
Laser technologies

IMPOL
Superplastic Al alloys

ISKRA TELA
Antenna systems

ZAVAROVALNICA MARIBOR
End-user of space technologies
### R&D activities

<table>
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<th>TECHNOLOGIES</th>
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<td>wp1: remote sensing</td>
<td>wp4: satellite technology</td>
<td>wp7: international missions</td>
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<td>wp2: meteorology</td>
<td>wp5: communications</td>
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<tr>
<td>![Meteorology Image]</td>
<td>![Communications Image]</td>
<td>![Terrestrial Applications Image]</td>
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<td>wp3: astrophysics</td>
<td>wp6: multidisciplinary lab</td>
<td>wp9: dissemination</td>
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<td>![Astrophysics Image]</td>
<td>![Multidisciplinary Lab Image]</td>
<td>![Dissemination Image]</td>
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Legend:
- **wp1**: remote sensing
- **wp2**: meteorology
- **wp3**: astrophysics
- **wp4**: satellite technology
- **wp5**: communications
- **wp6**: multidisciplinary lab
- **wp7**: international missions
- **wp8**: terrestrial applications
- **wp9**: dissemination
Microsatellite under development

- **70 kg satellite** for earth monitoring and observation
- **2.8 m gsd** from a reference altitude of 600 km
  - **four spectral channels**
    (450-520 nm, 520-600 nm, 630-690 nm, and 760-900 nm).
  - **high-definition video** at 1920 by 1080 pixels.
  - **real-time imaging and video streaming** over Slovenia

- **three-axis stabilized bus**
- **50 mbps x-band downlink**
  - 128 gb of on-board storage,
  - power system generating nearly 90 w
  - 100 w-h li-ion battery.

Ground control infrastructure
Number of active satellites

![Graph showing the number of active satellites over time]
Spatial resolution of images
Data volume

TB per year per 100 km²
WorldView-3 level of detail
Detection of Japanese knotweed
Disaster monitoring

Floods around Ljubljana in September 2010, RapidEye image 23.9.2010
Floods around Ljubljana in September 2010 rapid mapping product
Drought mapping

Interactive graphs:

Drought monitoring:

Satellite and ground data collection and synchronization → Data analysis for drought patterns recognition → Data modeling for drought detection → A system for drought monitoring

Multitemporal land cover classification:
Space-SI Processing chain is cloud ready

Remote sensing data
- Test data: RapidEye
- Various full-frame and pushbroom sensors

Geometric corrections
- Data preparation
- GCP extraction
- Orthorectification

Radiometric corrections
- Atmospheric correction
- Topographic correction

Generation of Results
- Change detection
- NDVI generation
- NDVI changes

End user Services
- Data catalog
- Web mapping of products
- End user triggered re-processing

S1, S2, S3

THEOS

WorldView-2

Pleiades

RapidEye
Establishment of a Sentinel processing and archiving cloud
Crowdsourcing

Close the loop between satellite developers, operators, expert users and general public
- Storms, hail
- Water levels
- Water pollution
Conclusions

• Satellites are generating huge amount of data
• Only information – report, yes/no, alert - is relevant to the end user
• Automatic processing is necessary
• Steps are defined and tested – ready to be implemented in the cloud
Conclusions

• ICT technologies
• Space and ground infrastructure
• Smart cities and communities
  • Spatial data
  • Planning
  • Crowdsourcing
• Smart use of resources
• Health
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