



Cloud computing for Earth observation

Krištof Oštir, Tomaž Rodič and Grega Milčinski

Slovenian Centre of Excellence for Space Sciences and Technologies,
Research Centre of the Slovenian Academy of Sciences and Arts and
Sinergise



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

ZAVAROVALNICA MARIBOR
End-user of space technologies



Companies:

DEWESOFT

Telemetry, data acquisition

SINERGISE

GIS applications

TIC LENS

Laser technologies


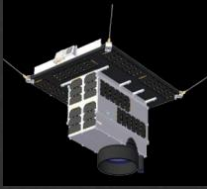

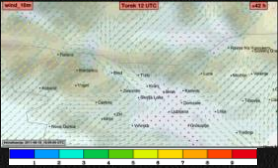


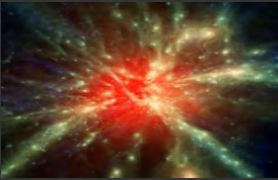
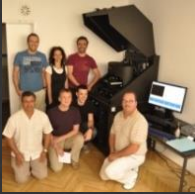

IMPOL

Superplastic Al alloys

ISKRA TELA

Antenna systems

R&D activities

SCIENCE	TECHNOLOGIES	APPLICATIONS
<p>wp1: remote sensing</p> 	<p>wp4: satellite technology</p> 	<p>wp7: international missions</p> 
<p>wp2: meteorology</p> 	<p>wp5: communications</p> 	<p>wp8: terrestrial applications</p> 
<p>wp3: astrophysics</p> 	<p>wp6: multidisciplinary lab</p> 	<p>wp9: dissemination</p> 

Microsatellite under development

70 kg satellite for earth monitoring and observation

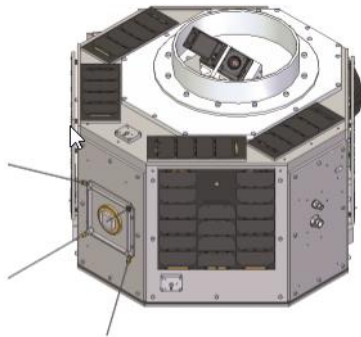
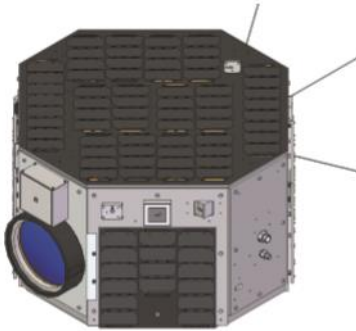
2.8 m gsd from a reference altitude of 600 km

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,

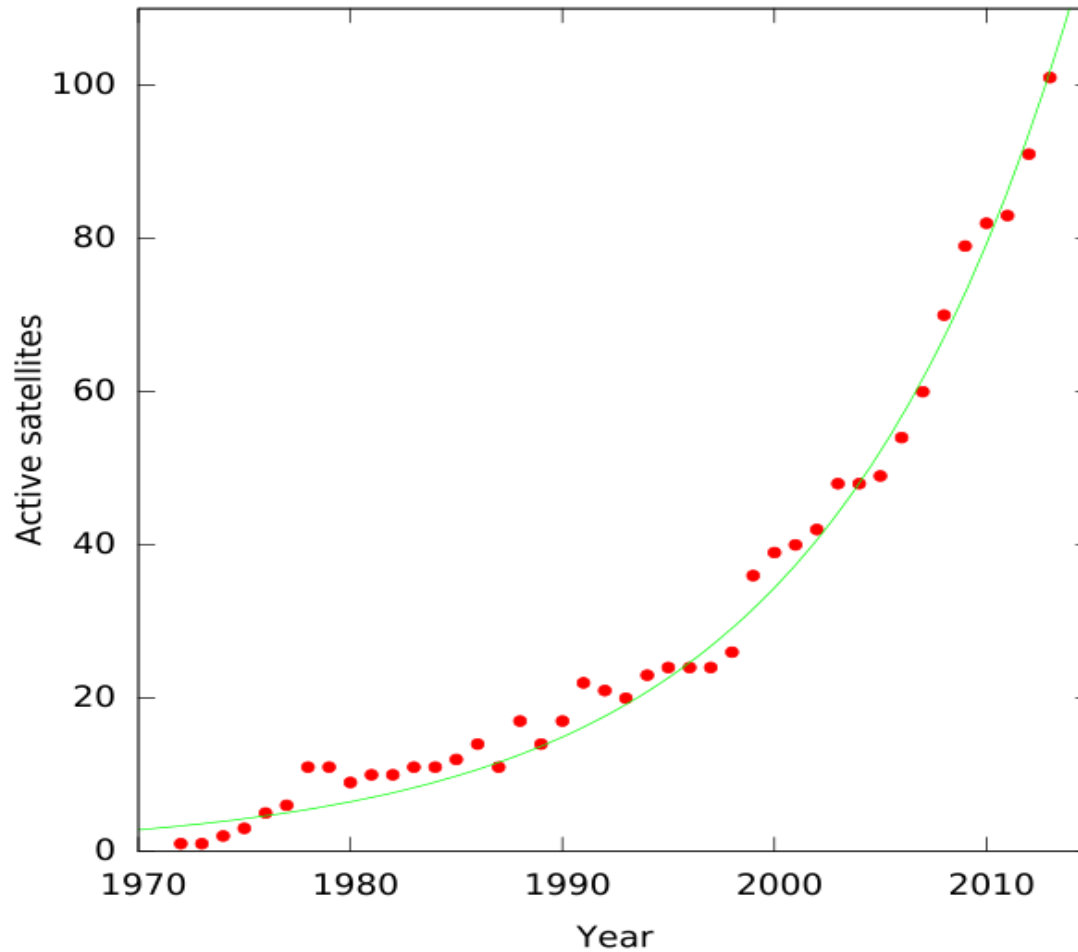
power system generating nearly 90 w

100 w-h li-ion battery.

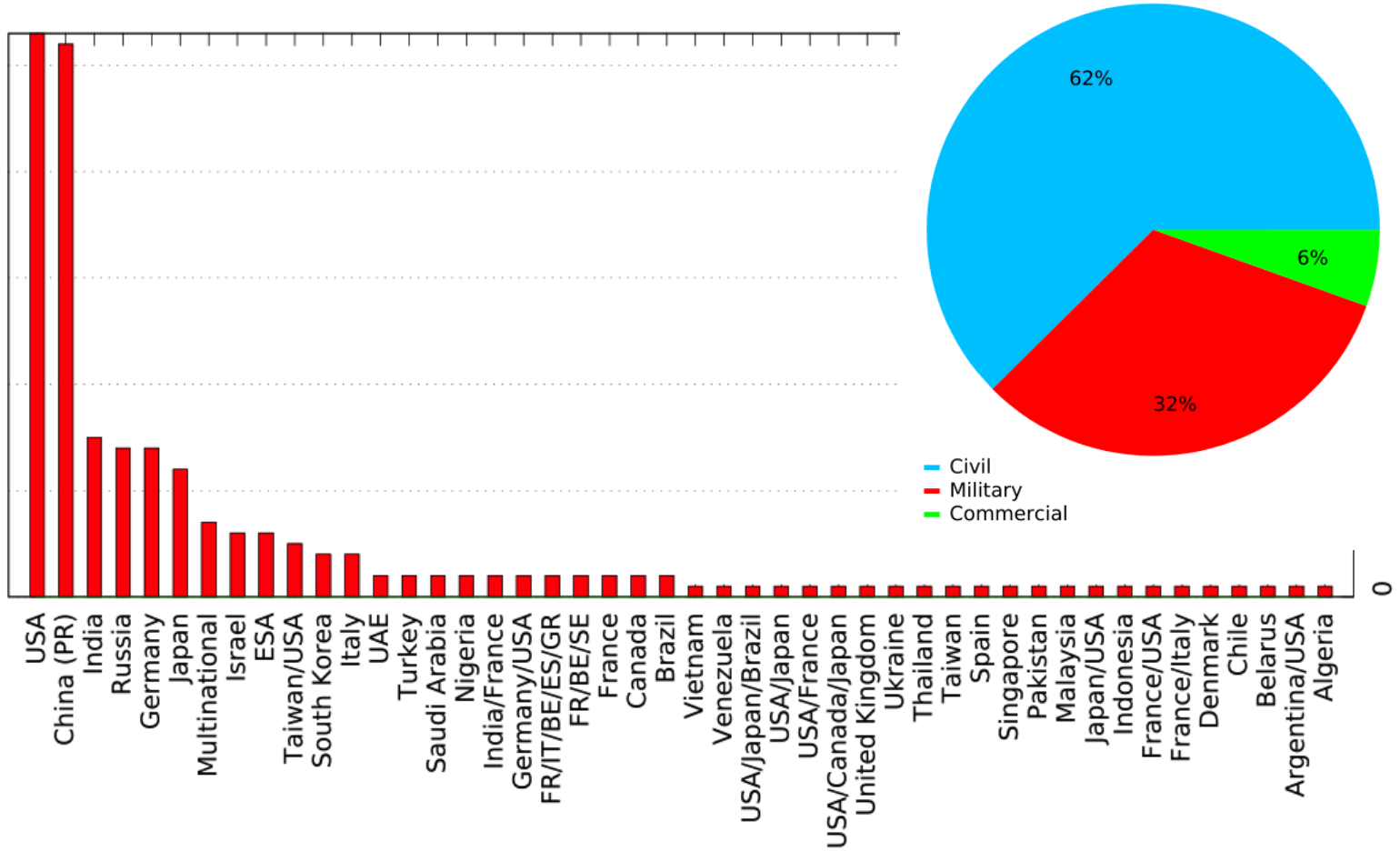
Ground control infrastructure



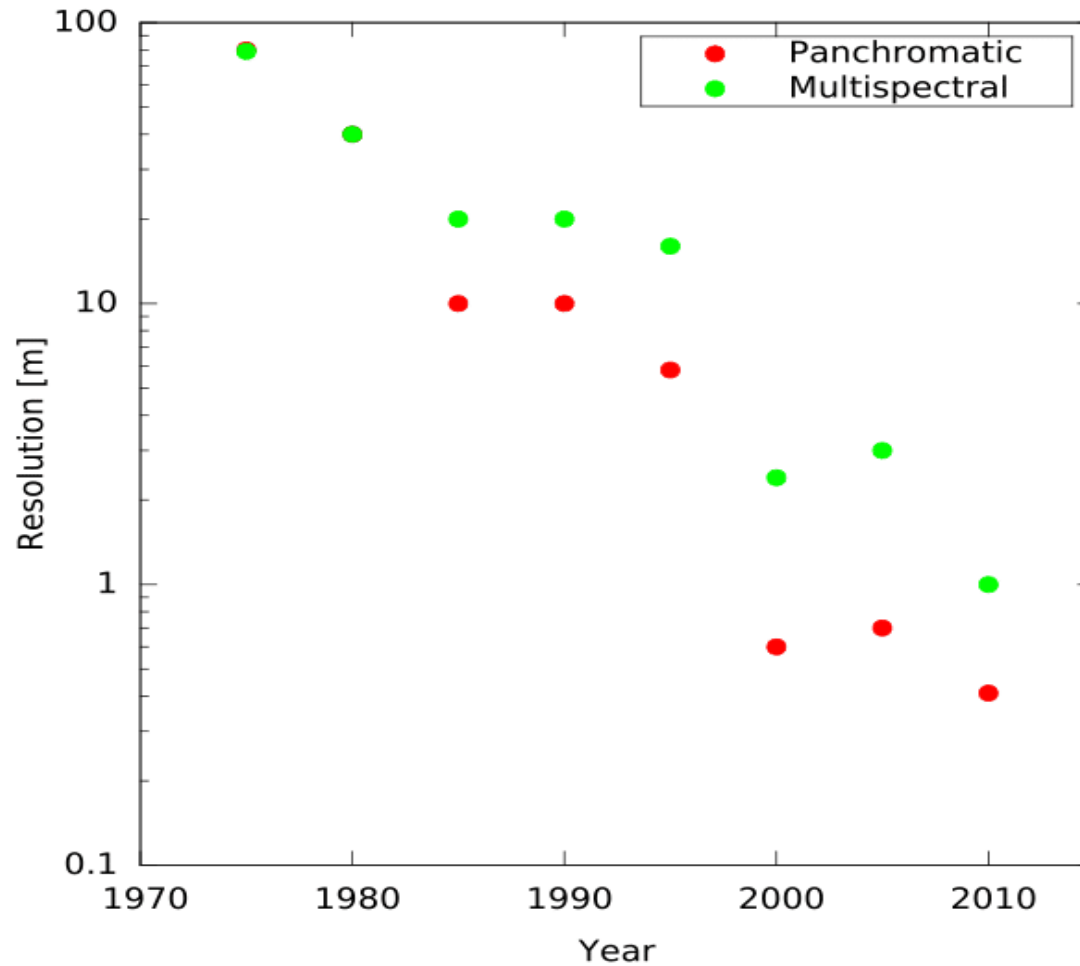
Number of active satellites



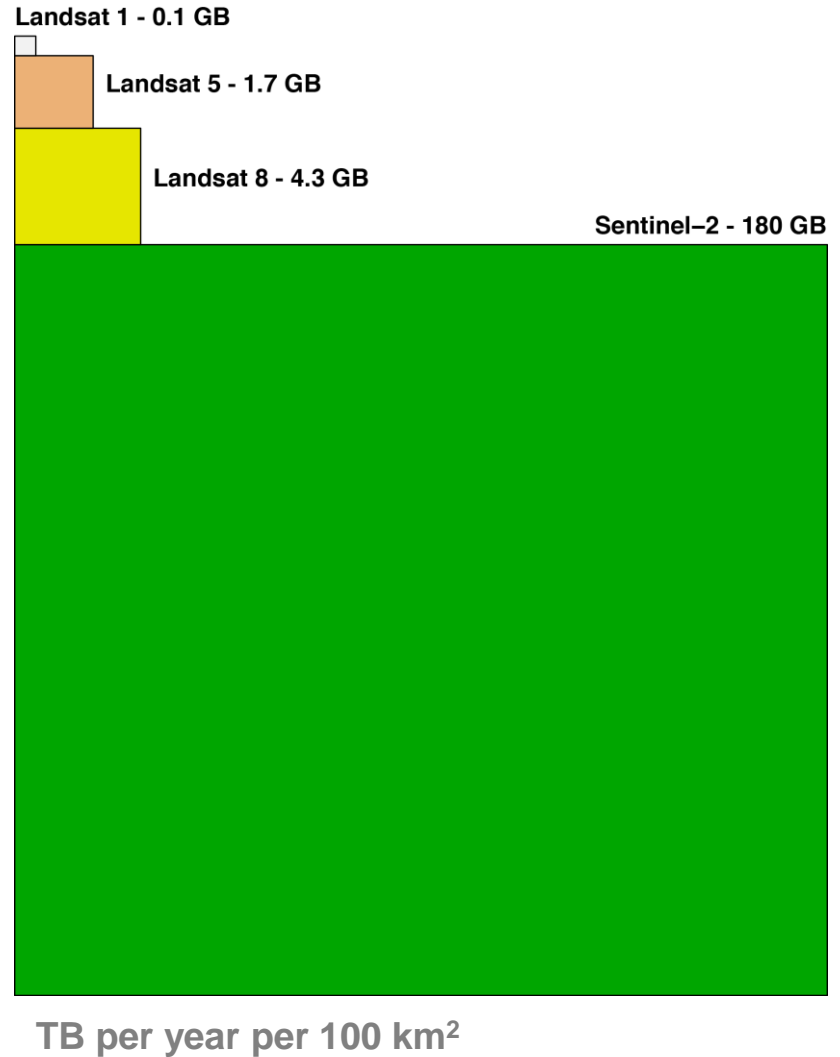
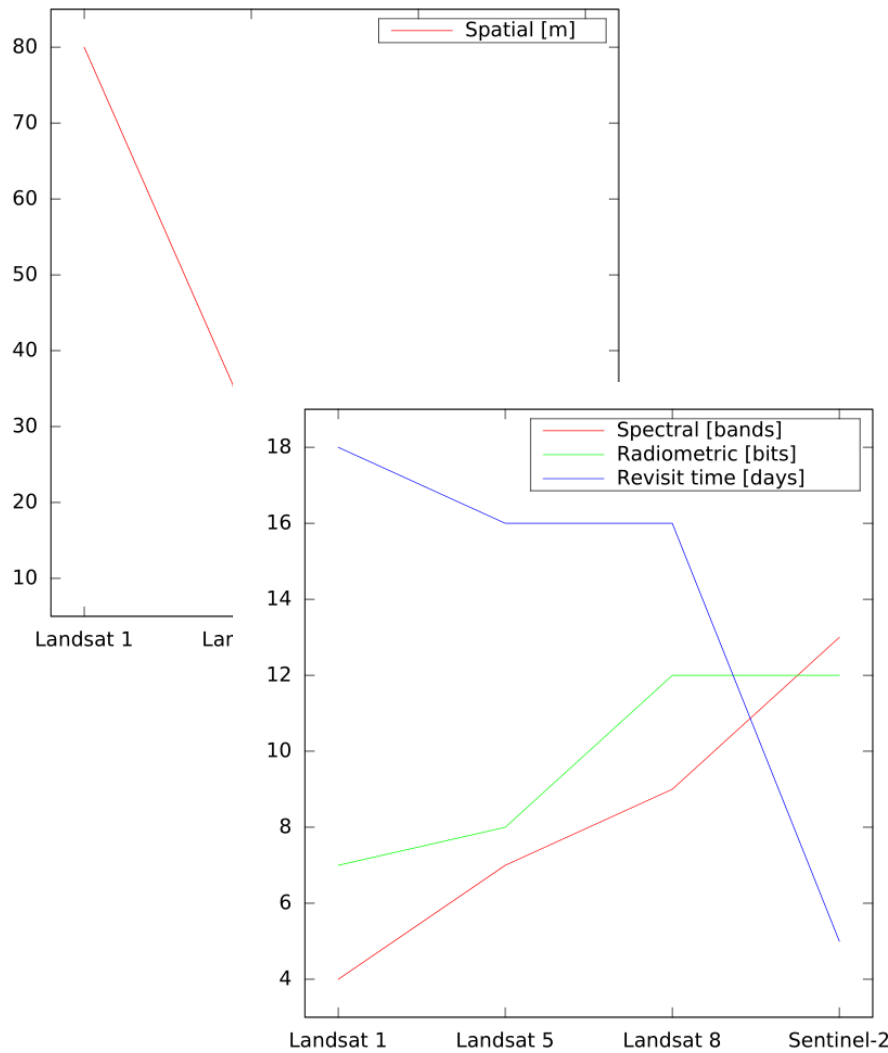
Satellites by country



Spatial resolution of images



Data volume



WorldView-3 level of detail



WorldView-3



WorldView-3



WorldView-3



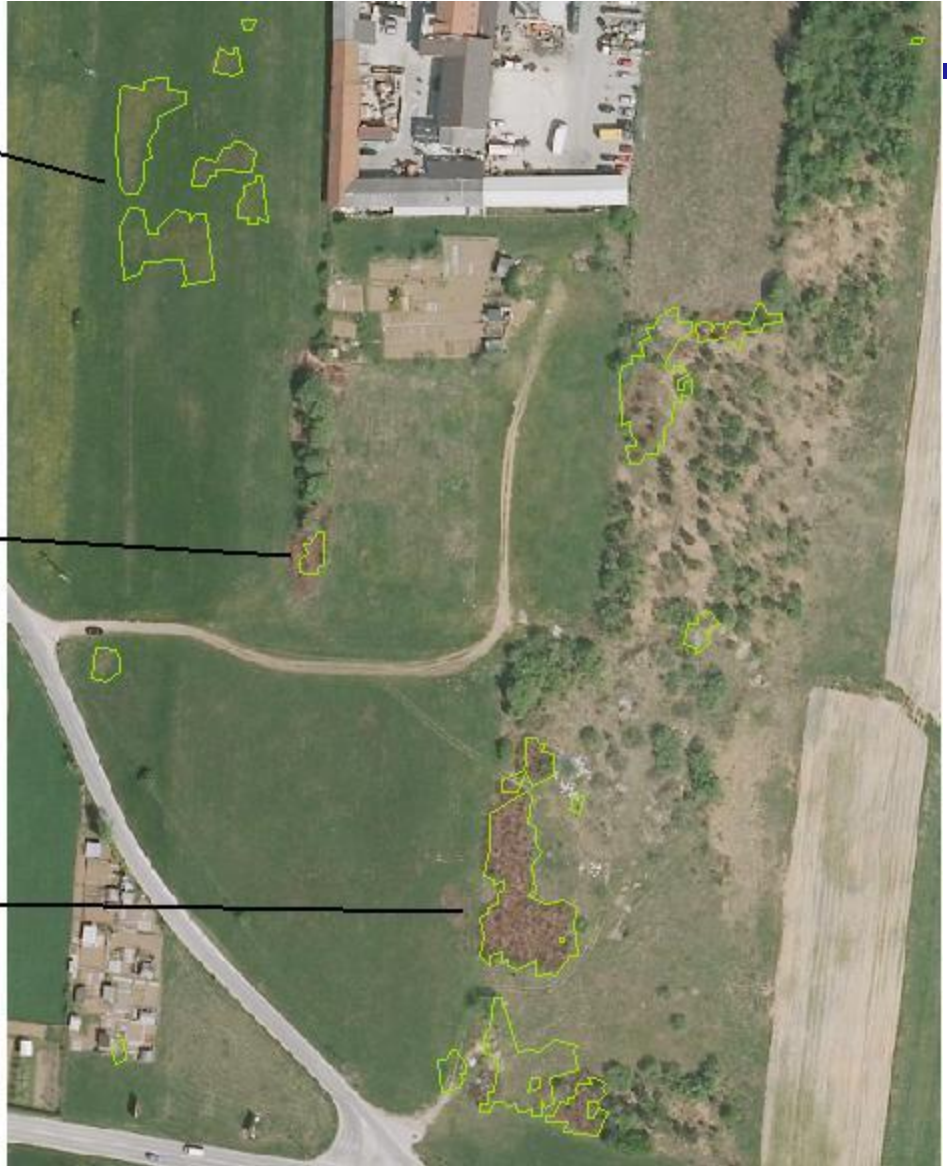
WorldView-3



Detection of Japanese knotweed

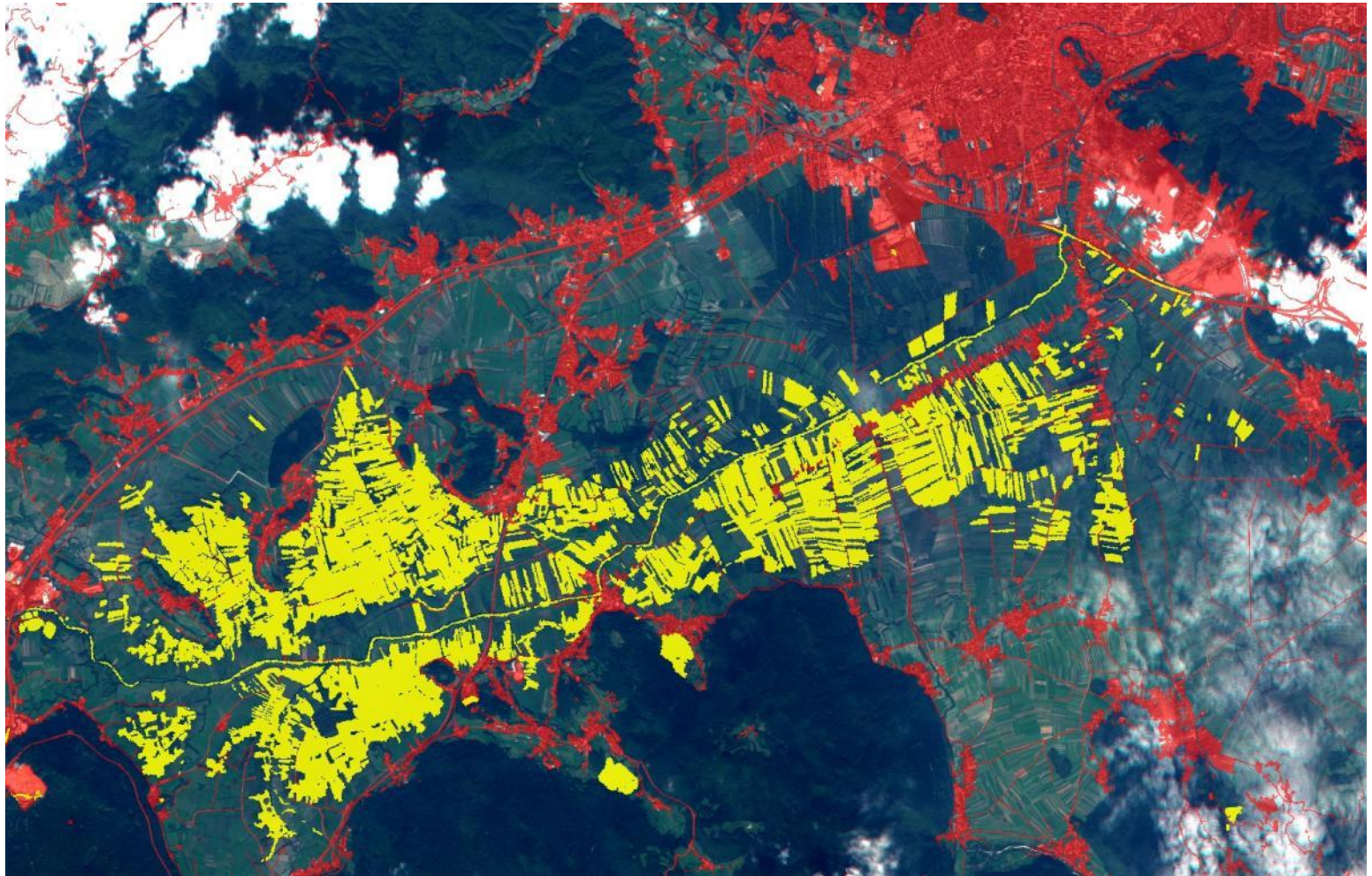




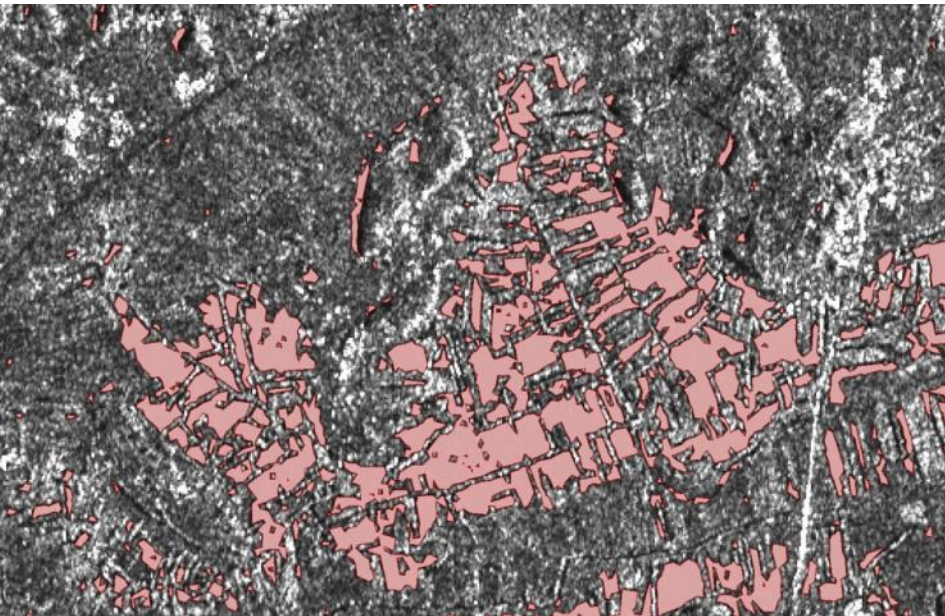


Disaster monitoring

Floods around Ljubljana in September 2010, RapidEye image 23.9.2010

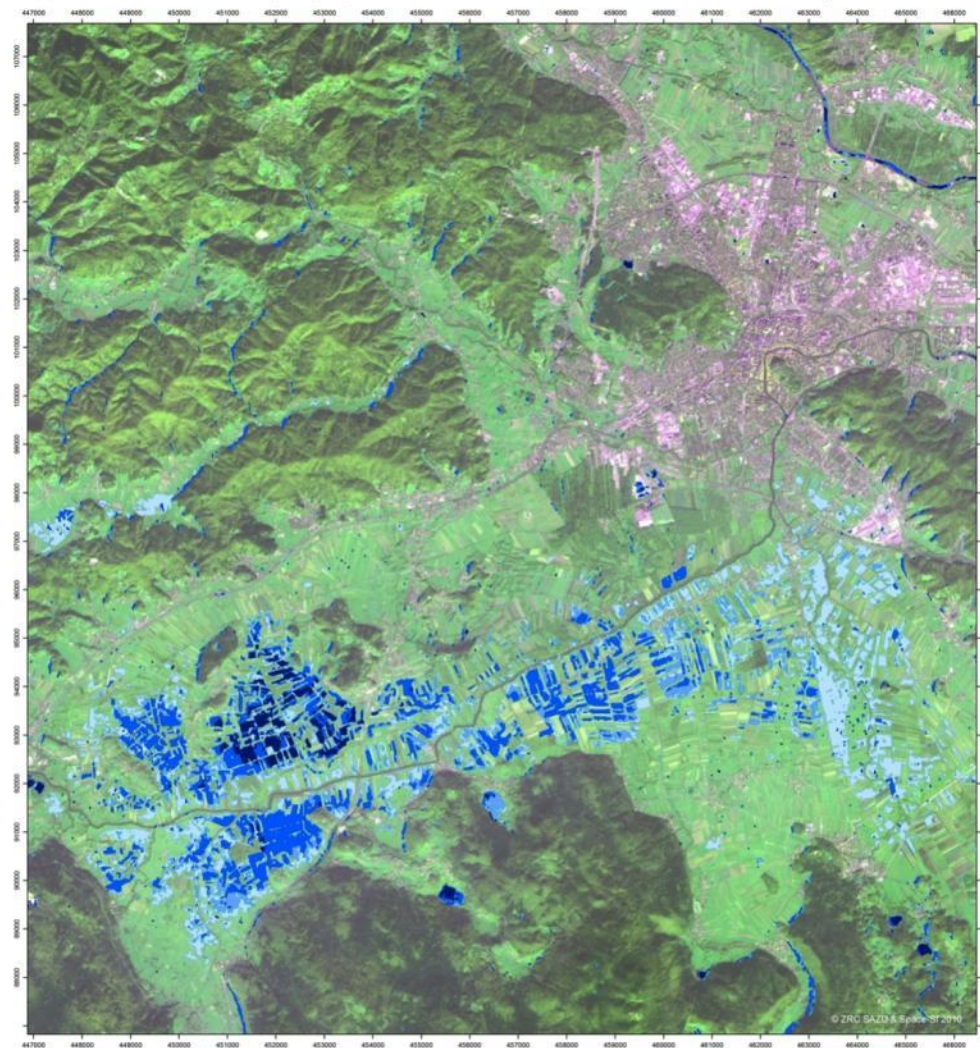


Radarsat-2



RapidEye





Overview map / Pregledna karta



Legend / Legenda

-  water extent - 19.9.2010 - ENVISAT ASAR
voda/popoljeno - 19.9.2010 - ENVISAT ASAR
-  water extent - 23.9.2010 - RADARSAT-2
voda/popoljeno - 23.9.2010 - RADARSAT-2
-  water extent - 26.9.2010 - RADARSAT-2
voda/popoljeno - 26.9.2010 - RADARSAT-2
-  water extent - 2.10.2010 - RADARSAT-2
voda/popoljeno - 2.10.2010 - RADARSAT-2

Processing and analysis

- ENVISAT ASAR image orthorectified and georeferenced, filtered and classified
- RADARSAT-2 images orthorectified and georeferenced, filtered and classified
- SPOT 5 georeferenced

Obdelava in analiza

- georeferenciranje in ortorektifikacija, filtriranje in klasifikacija satelitskega posnetka ENVISAT ASAR
- georeferenciranje in ortorektifikacija, filtriranje in klasifikacija satelitskih posnetkov RADARSAT-2
- SPOT 5 georeferenciranje

Interpretation

Heavy rains on September 17th to 19th 2010 triggered severe flooding in many parts of Slovenia. One of the most exposed areas was south-west part of capital Ljubljana, where two smaller rivers (Gradaščica and Ljubljanica) flooded heavily. Analysis of the ENVISAT ASAR satellite image of resolution 12.5 m, taken on the September 19th 2010 at around 21h GMT and a series of 12.5 m resolution RADARSAT-2 images acquired on 23.9.2010, 26.9.2010 and 2.10.2010, is shown. The flooded areas and its dynamics (water relation) are presented in blue color range. The total amount of flooded areas outside of Ljubljana can be clearly seen. Detection of flooding in urban parts was not possible due to scattering mechanisms of radar signals (geometry and composition of objects mix the signal). Similarly, all the areas where radar scattered on vegetation or tall crops expansion above the water are water-underestimated.

SPOT 5 image acquired on October 27, 2009 serves as background.

Interpretacija

Močno deževje med 17. in 19. septembrom 2010 je povzročilo močne poplave po Sloveniji. Eno izmed bolj prizadetih območij je bil jugovzhodni predel Ljubljane, kjer sta poplavljena Gradaščica in Ljubljanica. Na karti je v prikazani analizi satelitskega posnetka ENVISAT ASAR 12,5 m ločljivosti, zajetega 19.9.2010 okoli 21h GMT ter serije RADARSAT-2 posnetkov, zajetih 23.9., 26.9. in 2.10.2010, v enaki prostorski ločljivosti 12,5 m. Z razponom odtenov v modri so prikazane poplavljenе površine in njihova dinamična slika čas. Jasno je videti obseg poplavljenih območij zunaj Ljubljane. Zaznavanje poplav v urbanih delih ni bilo mogoče zaradi razpraz radarjskih signalov (geometrija objektov meša signali). Podobno so podcenjena tudi vsa območja, kjer radarjski signali skozi vegetacijo/visokozravnice poplavne na proste do vode na tleh. Za ozadje služi posnetek SPOT 5, zajet 27. oktobra 2009.

Cartographic info / Kartografski opis

Državni koordinatni sistem OŠ Slovenian national coordinate system OŠ
Projektor: Gauss-Krüger Projektor: Gauss-Krüger
Elipsoid: Everest 1841 Datum: Everest 1841
Merilo pri tisku na A3: 1:50.000 Škale for A3 printing: 1:50.000

0 500 1000 2000 m

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Data sources / Viri podatkov

ENVISAT ASAR satellite image / satelitski posnetki © ESA 2010
RADARSAT-2 satellite images / satelitski posnetki © MacDonald, Dettwiler and Associates LTD (2010) & CSA 2010
SPOT 5 satellite image / satelitski posnetki © Spot Image & CNES 2010
satellite data / satelitski podatki © ZRC SAZU & Space-IT 2010

International Charter Space and Major Disasters
Mechanism: vevic@post.gov.uk
<http://www.disastercharter.org>

Centre of Anthropological and Spatial Studies, ZRC SAZU
Institute for Anthropology and Spatial Studies, ZRC SAZU
<http://iass.zrc-sazu.si> <http://www.zrc-sazu.si>

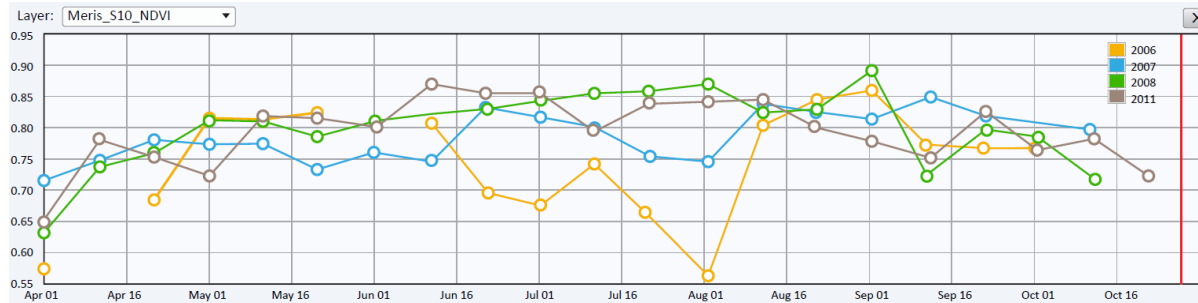
Center of Earth and Space-IT
Centre of Earth and Space-IT
<http://www.apes.si/>

Map produced / izdelano: 7.10.2010, © ZRC SAZU & Space-IT

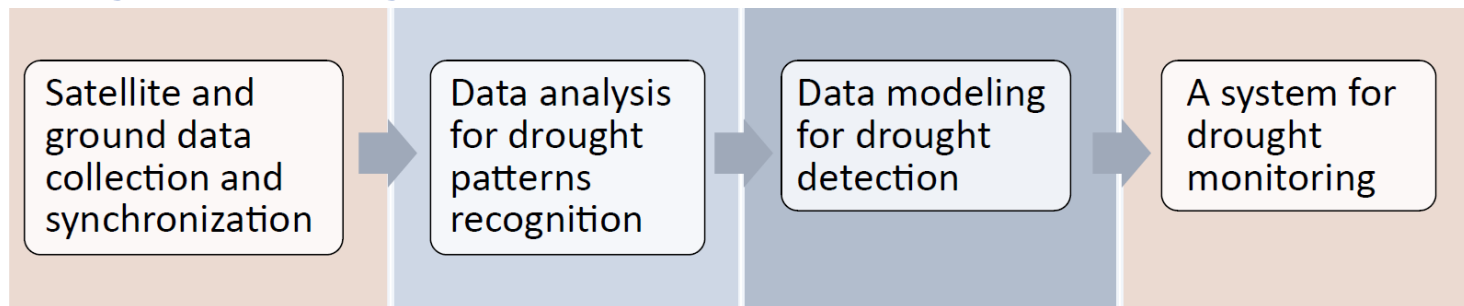
Floods around Ljubljana
in September 2010
rapid mapping product

Drought mapping

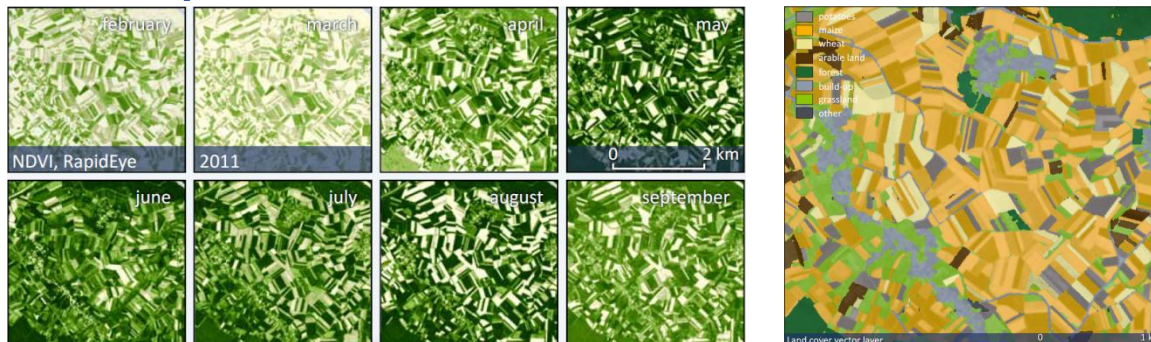
Interactive graphs:



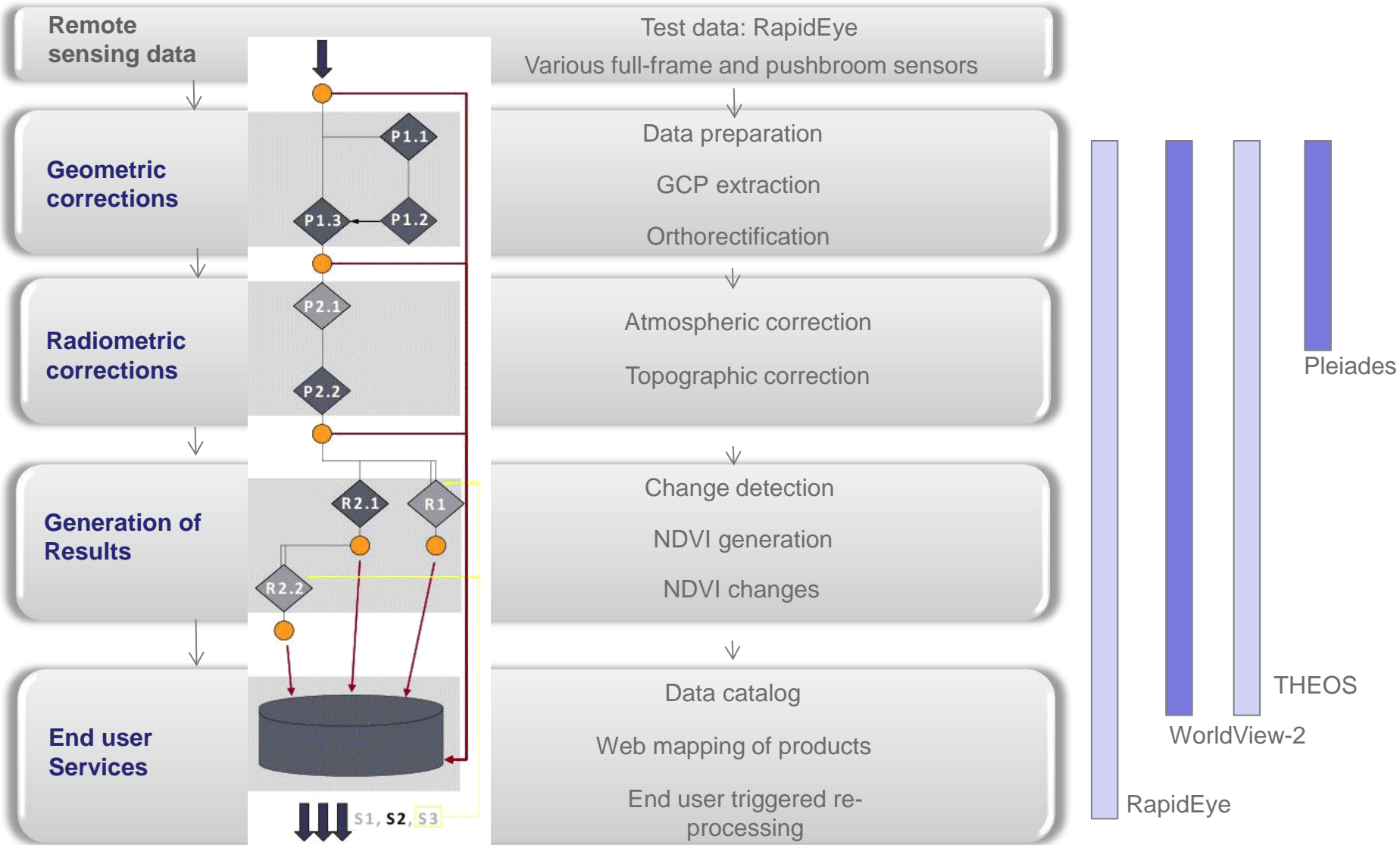
Drought monitoring:



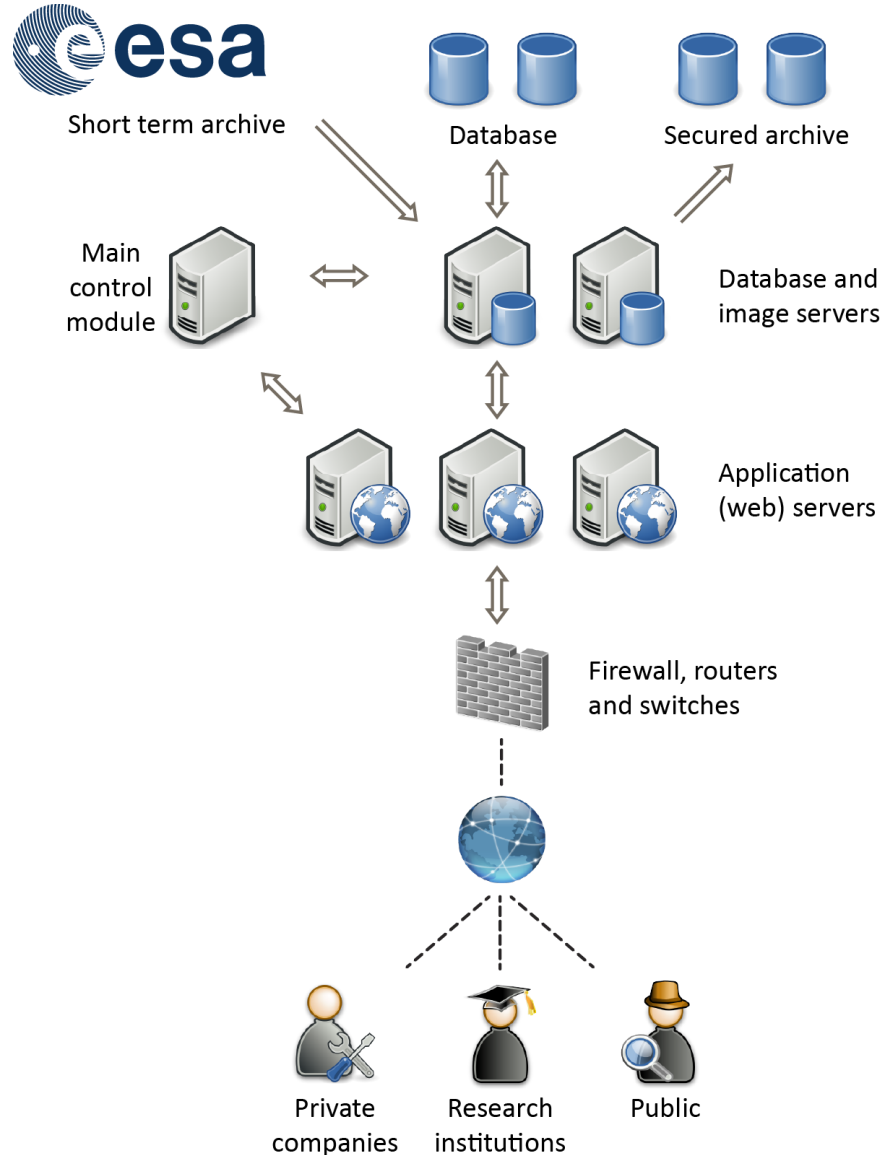
Multitemporal land cover classification:



Space-SI Processing chain is cloud ready



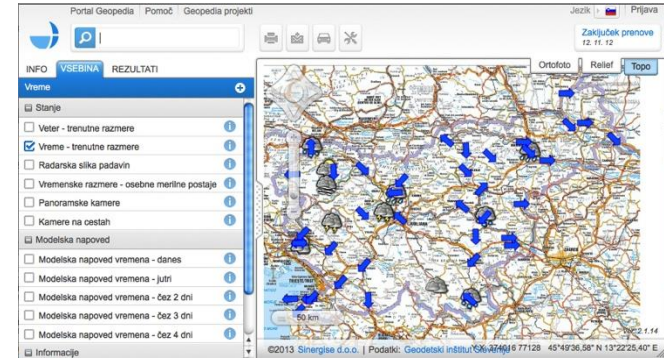
Establishment of a the Sentinel processing and archiving cloud



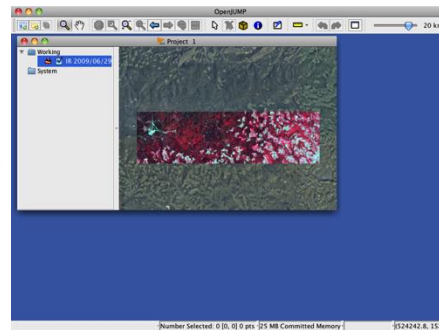
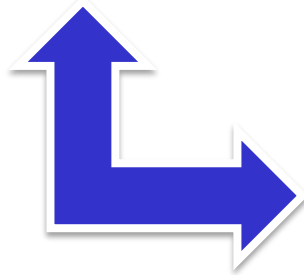
Crowdsourcing



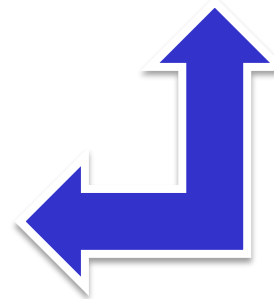
Mobile app



Web GIS



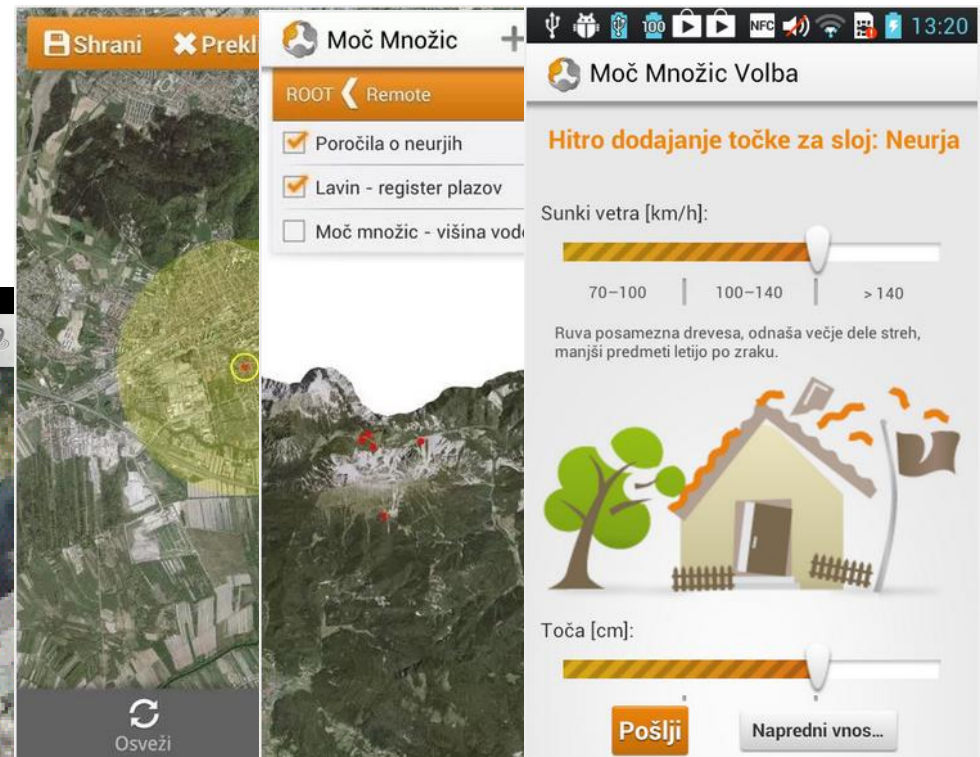
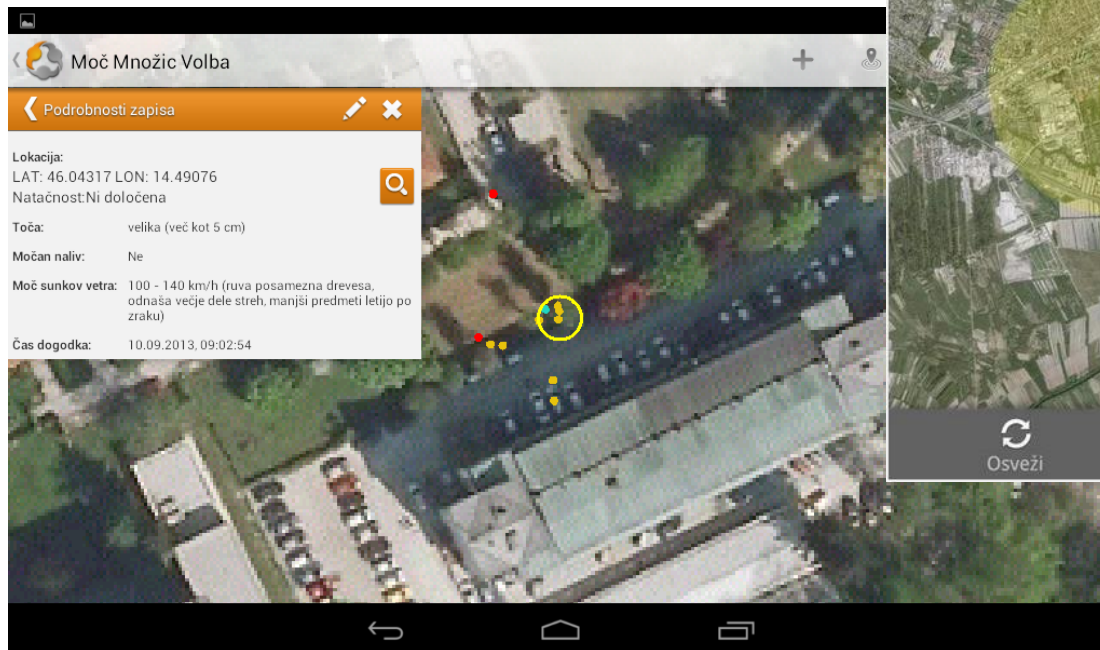
Web services




Close the loop between satellite developers, operators, expert users and general public

Mobile app

- 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



Contact:

kristof.ostir@space.si



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CENTRE OF EXCELLENCE
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W: <http://www.space.si>

E: office@space.si



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