



Growing  
**ideas**  
through  
**networks**

# Concept, Design and Implementation of a Prototype of a Spatial Data Infrastructure for UAS-based Environmental Monitoring

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# New challenges of UAS for Environmental Monitoring

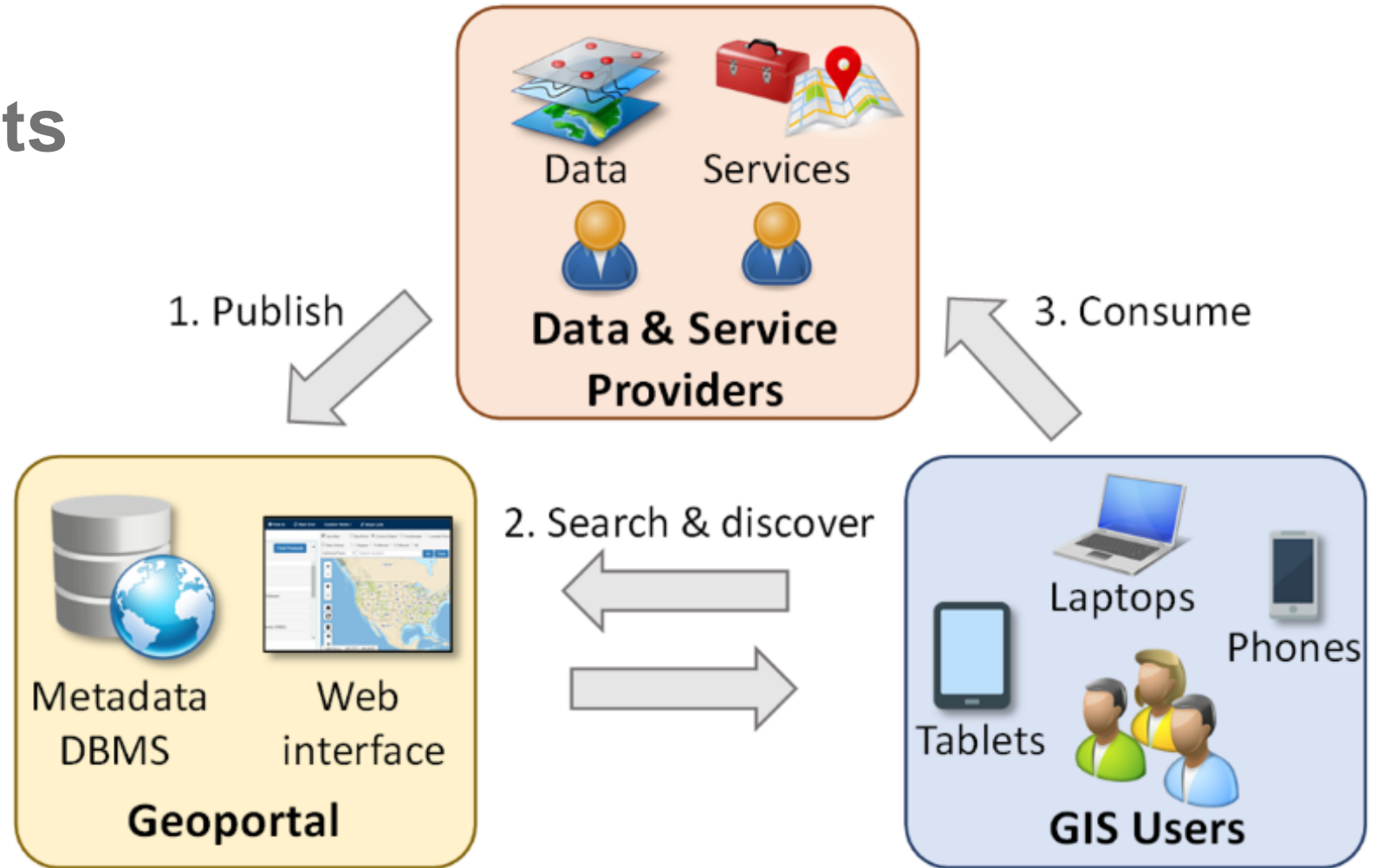
- the **processing** and **analysis** of very large data volumes
- the **integration** of different **sensor data**
- the recognition of real **environmental changes** in the environment versus mission related or UAS technology related artefacts
- the **automated generation of information** out of these data
- the **structured** and **organized storage** of data and **access** to these data – **Spatial Data Infrastructure (SDI)**

# Definitions

- **Spatial Data Infrastructure**: The technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data, services, and other digital resources.
- **Geoportal**: A gateway website through which people can search, discover, access, and visualize the geospatial resources within a SDI.
- **Metadata**: Documentation about who, when, how, what, why, and many other facets of the data and the data production process. Metadata can be used for describing not only data, but also tools, services, and other geospatial resources.
- **Data standard**: A commonly agreed specification on how data should be recorded and described.
- **Geospatial Interoperability**: The ability of different geographic information systems to share, exchange, and operate (heterogenous) geospatial data and functions.
- **Webservice**: A Web application that provides standardized application programming interfaces to allow remote access to data and functions over the Internet.

# Key components of a SDI

Publish - Find - Bind





## Home

This Geoportal provides selected geospatial data processed within the scope of the project RPAmSS.

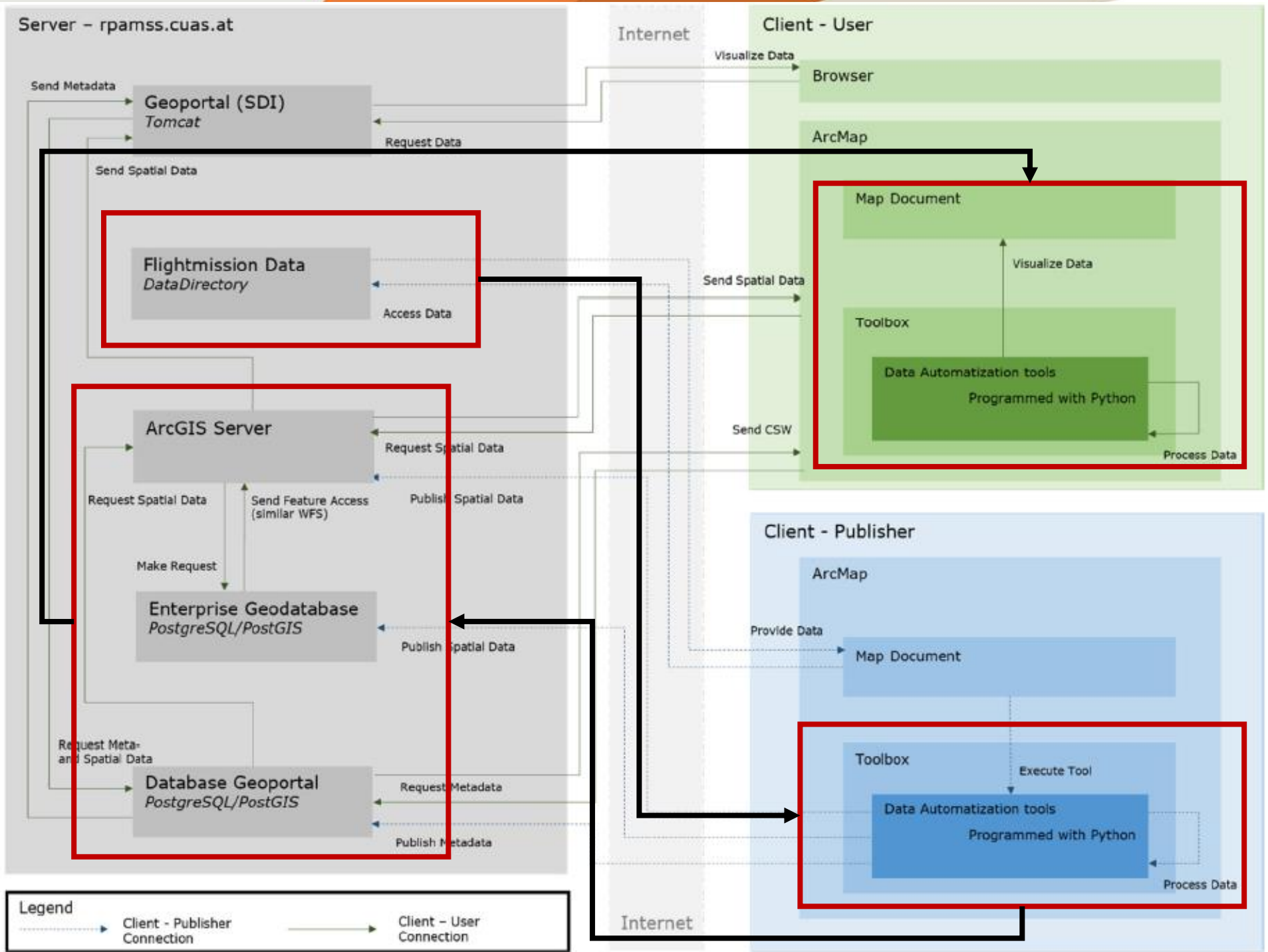
### You can simply...

Find Data

Search

### You can do more...





# System Architecture

# UAS Flight Mission Data – Hierarchical Folder & File Structure

Template name	Comment	Examples
<b>Folder</b> <b>YYYY-MM-DD Place optionalSUBPLACE</b>	YYYY      year MM        month DD        day Place     place of the mission SUBPLACE   empty or NORTH, EAST, SOUTH, or WEST	→ 2015-02-27 Feldkirchen → 2015-02-27 Feldkirchen SOUTH → 2015-02-27 Feldkirchen WEST
<b>Folder</b> <b>Mission_x_SENSORTYPE</b>	x            Mission number of the flight      mission SENSORTYPE   sensor type, like RGB, NIR, HYPERSPECTRAL	→ Mission_1_RGB → Mission_1_NIR → Mission_2_RGB → Mission_3_HYPERSPECTRAL
<b>File Metadata</b> <b>YYYYMMDD_Place_optionalSUBPL            ACE_Missionx_SENSORTYPE_Meta            data.xlsx</b>	YYYY      year MM        month DD        day Place     place of the mission SUBPLACE   empty or NORTH, EAST, SOUTH, or WEST  x            flightmission number SENSORTYPE   sensor type  <i>Use the RPAMSS Excel template for            correct metadata structure.            Exactly 1 metadata file is allowed.</i>	→ 20150227_Feldkirchen_Mission1_RGB_Metadata.xlsx → 20150227_Feldkirchen_SOUTH_Mission2_NIR_Metadata.xlsx
<b>Folder</b> <b>00 Planning</b>	Save the flightplan kml of the YYYY-MM-DD Place optionalSUBPLACE /Mission_x_SENSORTYP mission into this folder	→ Keep this folder name

# UAS Mission Data – Hierarchical Folder & File Structure

<p><i>File Flightplan</i>  <b>YYYYMMDD_Place_optionalSUB  PLACE_Missionx_SENSORTYPE_  Flightplan.kml</b></p>	<p>YYYY            year  MM                month  DD                day  Place            place of the mission  SUBPLACE       empty or NORTH,                           EAST, SOUTH, or WEST  x                    flightmission number  SENSORTYPE     sensor type</p> <p><i>Will be converted to shapefile.</i></p>	<p>→ 20150227_Feldkirchen_Mission1_RGB_Flightplan.kml  → 20150227_Feldkirchen_SOUTH_Mission2_NIR_Flightplan.kml</p>
<p><b>Folder</b>  <b>01 Flight</b></p>	<p>Save the trajectory csv of the YYYY-MM-DD Place optionalSUBPLACE /Mission_x_SENSORTYP mission into this folder</p>	<p>→ Keep this folder name</p>
<p><i>File Trajectory</i>  <b>YYYYMMDD_Place_optionalSUB  PLACE_Missionx_SENSORTYPE_  Trajectory.csv</b></p>	<p>YYYY            year  MM                month  DD                day  Place            place of the mission  SUBPLACE       empty or NORTH,                           EAST, SOUTH, or WEST  x                    flightmission number  SENSORTYPE     sensor type</p> <p><i>Will be converted to shapefile.</i></p>	<p>→ 20150227_Feldkirchen_Mission1_RGB_Trajectory.csv  → 20150227_Feldkirchen_SOUTH_Mission2_NIR_Trajectory.csv</p>
<p><b>Folder</b>  <b>02 Analyses</b></p>	<p>Save all analyses of the YYYY-MM-DD Place optionalSUBPLACE /Mission_x_SENSORTYP mission into this folder</p>	<p>→ Keep this folder name</p>
<p><b>Folder</b>  <b>NotToPublish</b></p>	<p>Save additional results in this folder. Everything within this folder will not be published.</p>	<p>→ Keep this folder name  Everything within this folder will be ignored during the publishing process.</p>

# UAS Mission Data – Hierarchical Folder & File Structure

## *File Analysis*

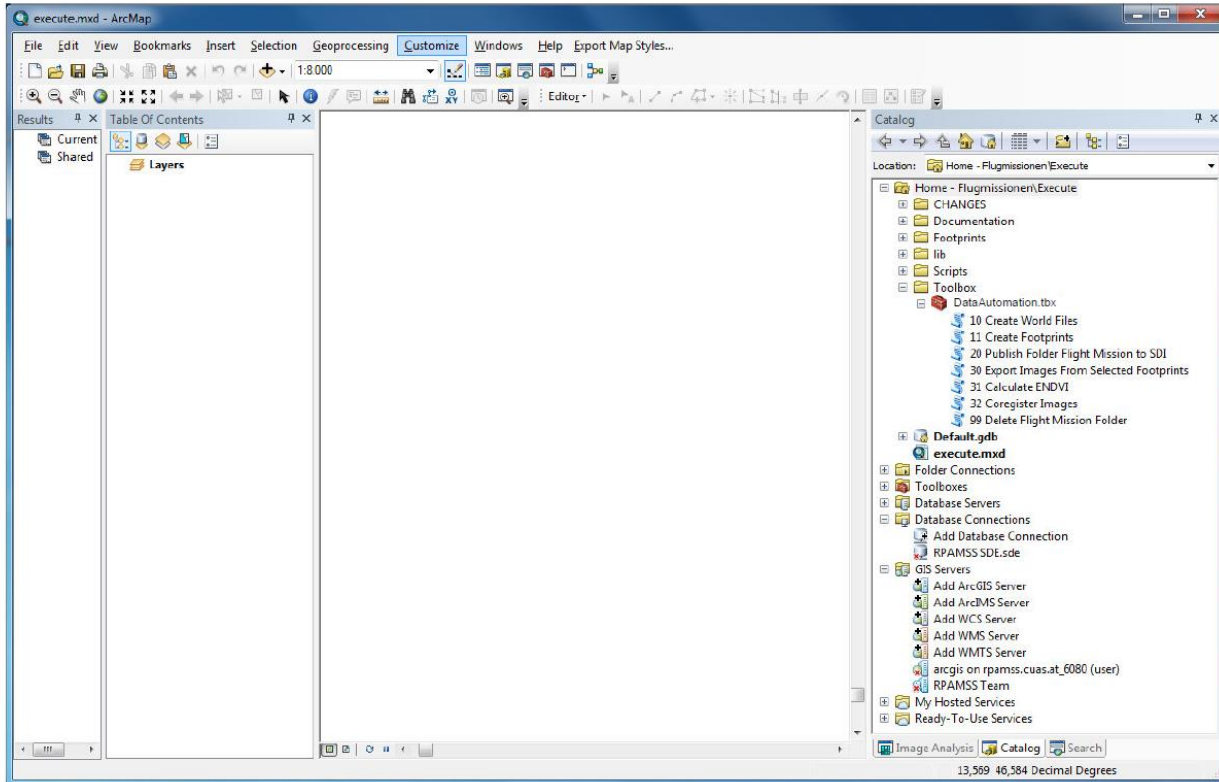
**YYYYMMDD\_Place\_optionalSUB  
PLACE\_Missionx\_SENSORTYPE\_  
Analysis.data  
format**

YYYY	year
MM	month
DD	day
Place	place of the mission
SUBPLACE	empty or NORTH, EAST, SOUTH, or WEST
x	flightmission number
SENSORTYPE	sensor type
Analysis	type of analysis, like Orthomosaic, DSM, NDVI, Footprints do not use characters like "/", "\", "_"
dataformat	dataformat = file extension, like tif, shp

*Save shp, tif, etc. and all its  
corresponding files*

→ 20150227\_Feldkirchen\_Mission1\_RGB\_Orthomosaic.tif  
 → 20150227\_Feldkirchen\_SOUTH\_Mission2\_RGB\_DSM.tif  
 → 20150227\_Feldkirchen\_Mission2\_HYPERSTRECTRAL\_NDVI.shp  
 → 20150227\_Feldkirchen\_Mission1\_RGB\_Footprints.shp

# Automated UAS Data Processing for Publisher & User



- + Scripts
- Toolbox
  - DataAutomation.tbx

- 10 Create World Files
- 11 Create Footprints
- 20 Publish Folder Flight Mission to SDI

- 30 Export Images From Selected Footprints
- 31 Calculate ENDVI
- 32 Coregister Images

- 99 Delete Flight Mission Folder

- + Default.gdb
- execute.mxd

- + Folder Connections
- + Toolboxes
- + Database Servers
- Database Connections
  - + Add Database Connection
  - RPAMSS SDE.sde
- GIS Servers

# Geoportal Search Options

a) Search by Text Using ~ Wildcard.  
All Matching Results Are Listed on the Right.

RPAmSS Geoportal

rpamss.cuas.at:8081/geoportal/catalog/search/search.page

Search

Text: orthomosaik~

Records shown from: This Site

Additional Options Clear

WHEN

Intersecting Fully within

Start Date: (yyyy-mm-dd)

End Date: (yyyy-mm-dd)

WHERE

Anywhere Intersecting Fully within

Text: yllbach

Results 1-0 of 0 records:

Expand All Zoom To Results Zoom To Search Area

- 20160304\_Feistritz\_Mission1\_NIR\_Orthomosaik
- 20160304\_Feistritz\_Mission1\_RGB\_Orthomosaik
- 20151203\_Obergottesfeld\_Mission2\_NIR\_Orthomosaik
- 20151203\_Obergottesfeld\_Mission1\_RGB\_Orthomosaik
- 20151210\_Aquantum\_Mission2\_RGB\_Orthomosaik
- 20151210\_Aquantum\_Mission1\_NIR\_Orthomosaik
- 20151229\_Feistritz\_Winter\_Mission2\_NIR\_Orthomosaik
- 20151229\_Feistritz\_Winter\_Mission1\_RGB\_Orthomosaik

See results through REST

API: GDRSS ATOM HTML FRAGMENT KML JSON DCAT CSV

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b) Search by Text Using \* Wildcard. All Further Possibilities for Results. Zoom to Selected Result.

RPAmSS Geoportal

rpamss.cuas.at:8081/geoportal/catalog/search/search.page

Search

Text: 20160304\_Feistritz\*RGB\*

Records shown from: This Site

Additional Options Clear

WHEN

Intersecting Fully within

Start Date: (yyyy-mm-dd)

End Date: (yyyy-mm-dd)

WHERE

Anywhere Intersecting Fully within

Text:

Results 1-6 of 6 records:

Expand All Zoom To Results Zoom To Search Area

- 20160304\_Feistritz\_Mission1\_RGB\_Footprints
- 20160304\_Feistritz\_Mission1\_RGB\_Orthomosaik
- 20160304\_Feistritz\_Mission1\_RGB\_DSM
- 20160304\_Feistritz\_Mission1\_RGB\_Trajectory
- 20160304\_Feistritz\_Mission1\_RGB\_Flightplan
- 20160304\_Feistritz\_Mission1\_RGB\_Metadata

RGB Schnee-Mission in Feistritz/Dall auf 100m Flughöhe bei 70% / 70% Überlappung / Sidelap (Winter-Flugplan)

Details Metadata Zoom To

See results through REST

API: GDRSS ATOM HTML FRAGMENT KML JSON DCAT CSV

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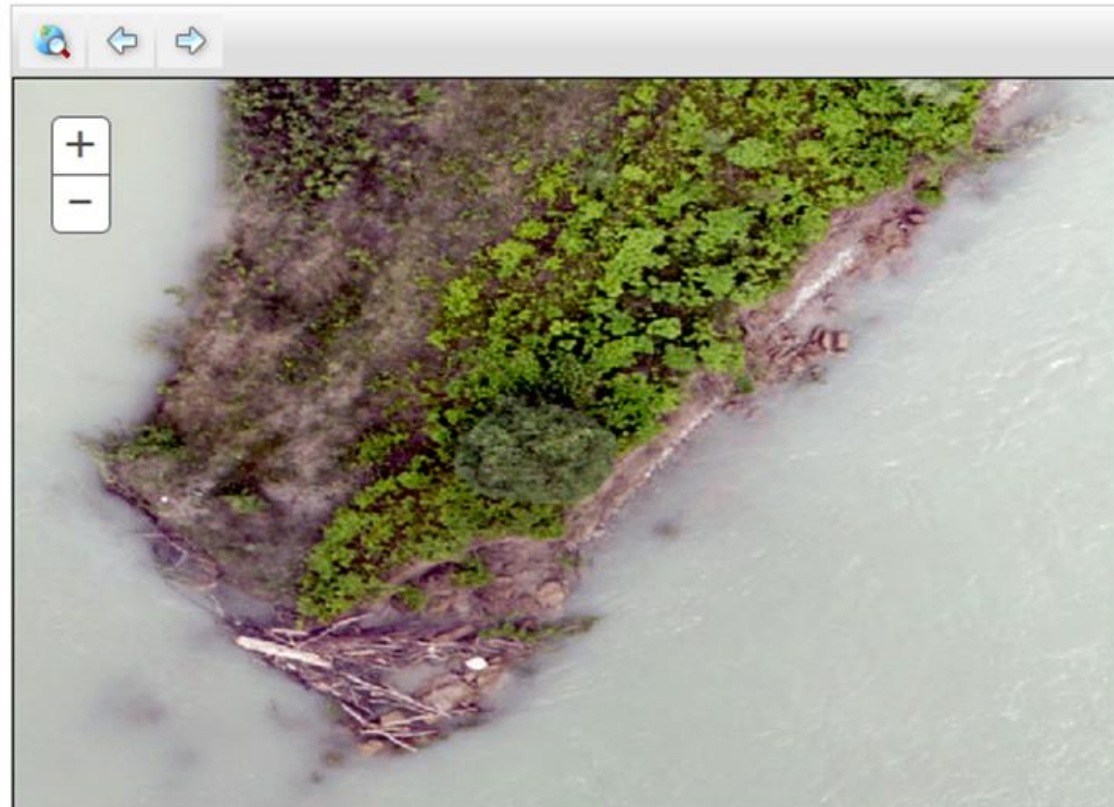


[Details](#) [Review](#) [Relationships](#) [Preview](#)

## 20160610\_Obergottesfeld\_Mission1\_RGB\_Orthomosaik

URL: [http://rpamss.cuas.at:6080/arcgis/rest/services/2016\\_06\\_10\\_Obergottesfeld/20160610\\_Obergottesfeld\\_Mission1\\_RGB\\_Orthomosaik/Ma](http://rpamss.cuas.at:6080/arcgis/rest/services/2016_06_10_Obergottesfeld/20160610_Obergottesfeld_Mission1_RGB_Orthomosaik/Ma)

Embed: `<iframe src="http://rpamss.cuas.at:8081/geoportal/catalog/livedata/embed.jsp?url=http%3A%2F%2Frpamss.cuas.at%3A6080%2Farcg`



 20160610\_Obergottesfeld\_Mission1\_RGB\_Orthomosaik

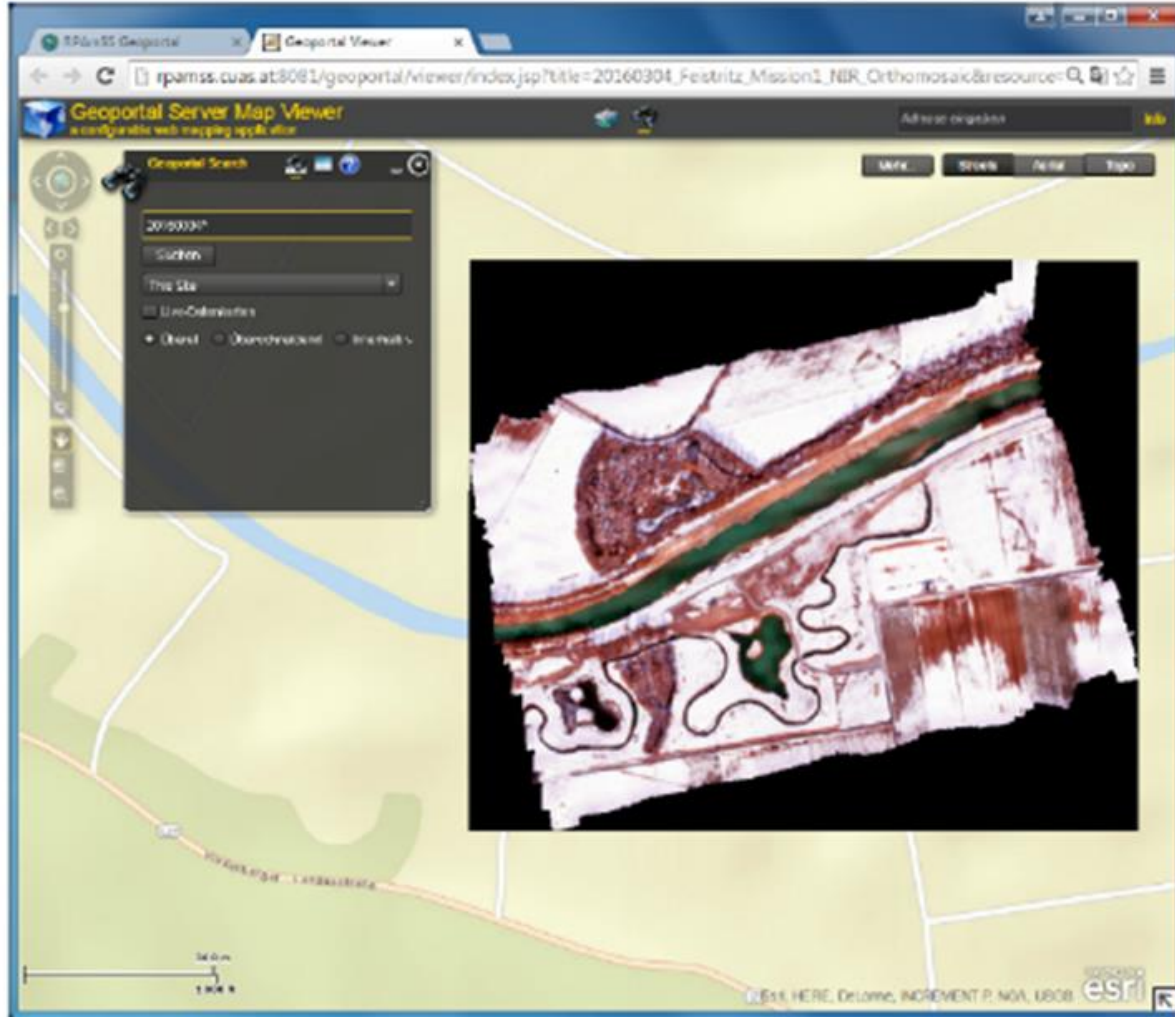
[Open Preview Globe \(.kml\)](#) [ArcGIS \(.nmf\)](#) [ArcGIS \(.lyr\)](#) [Add To Map](#)

[Details](#) [Metadata](#)

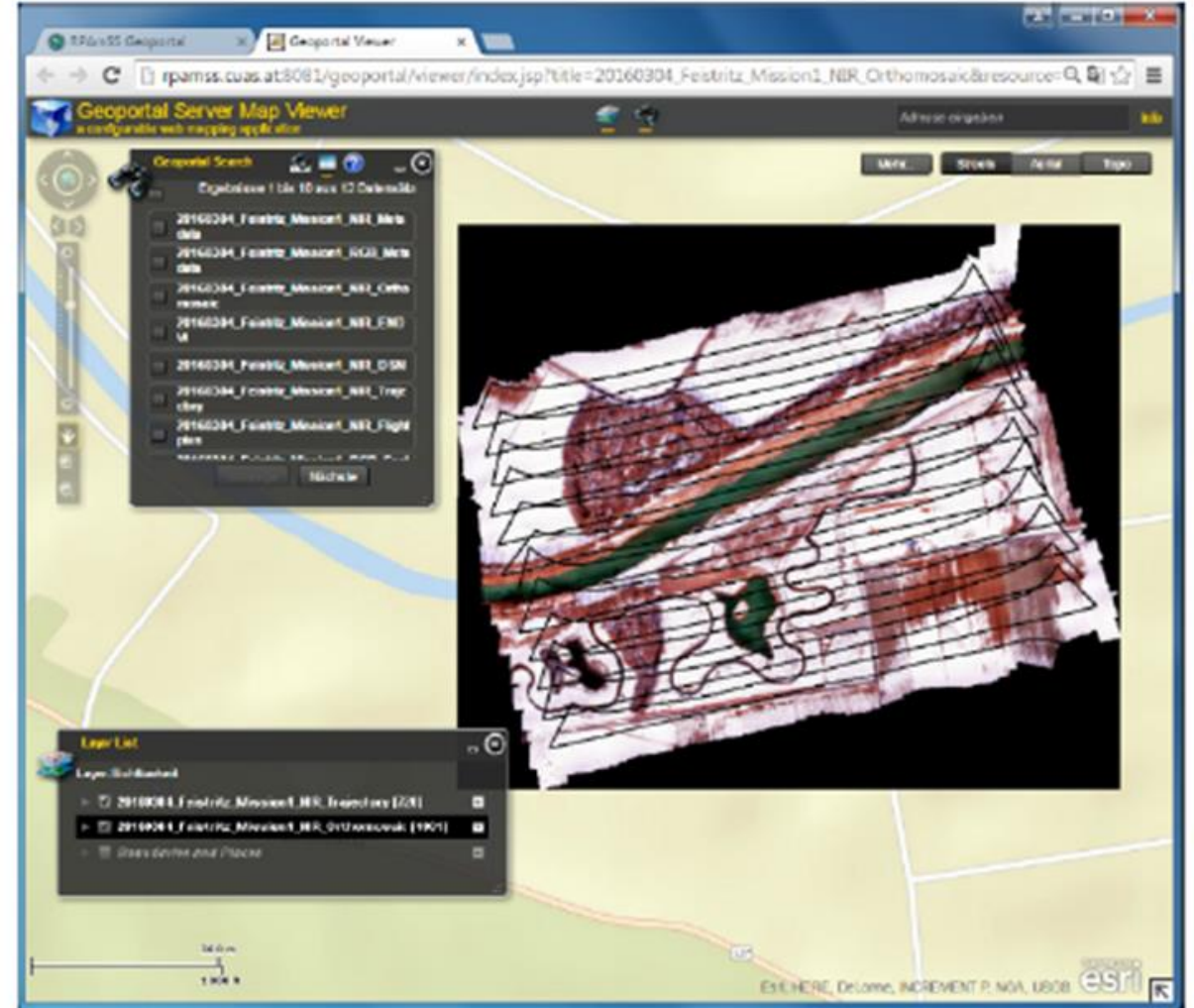
# Geoportal Preview

# Geoportal Map Viewer

a) Base Map with Orthomosaic of Feistritz

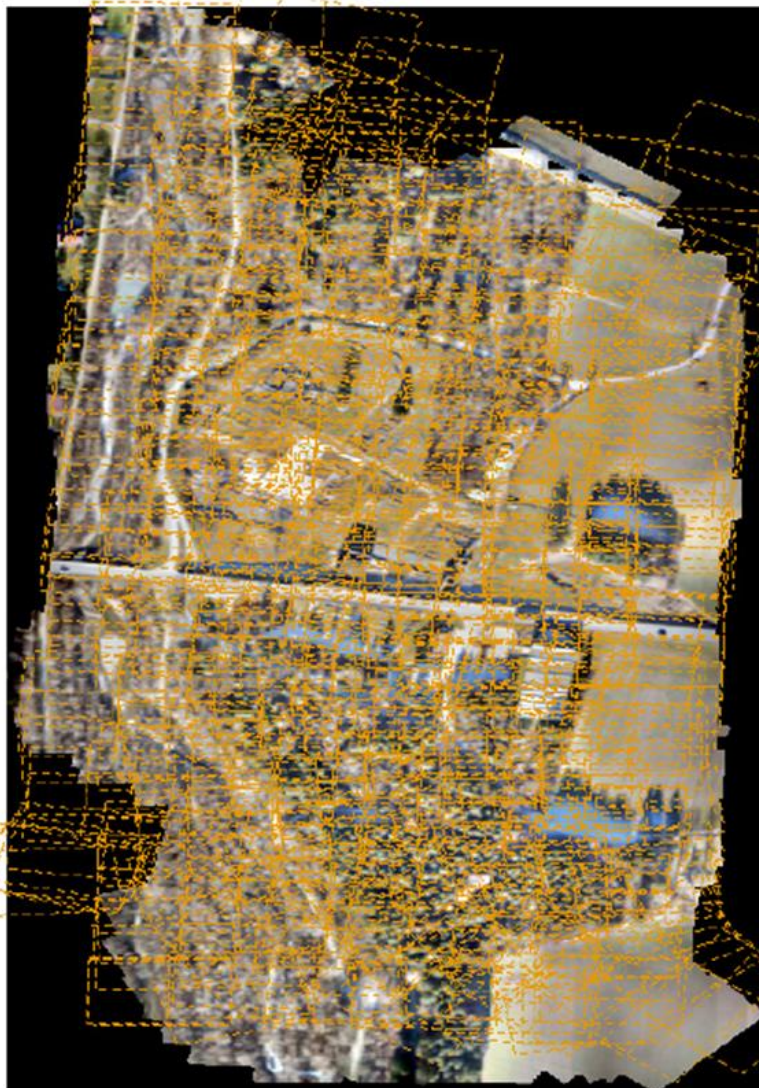


b) Orthomosaic of Feistritz and the Drone's Trajectory



# Select and Export Individual Images by Footprints

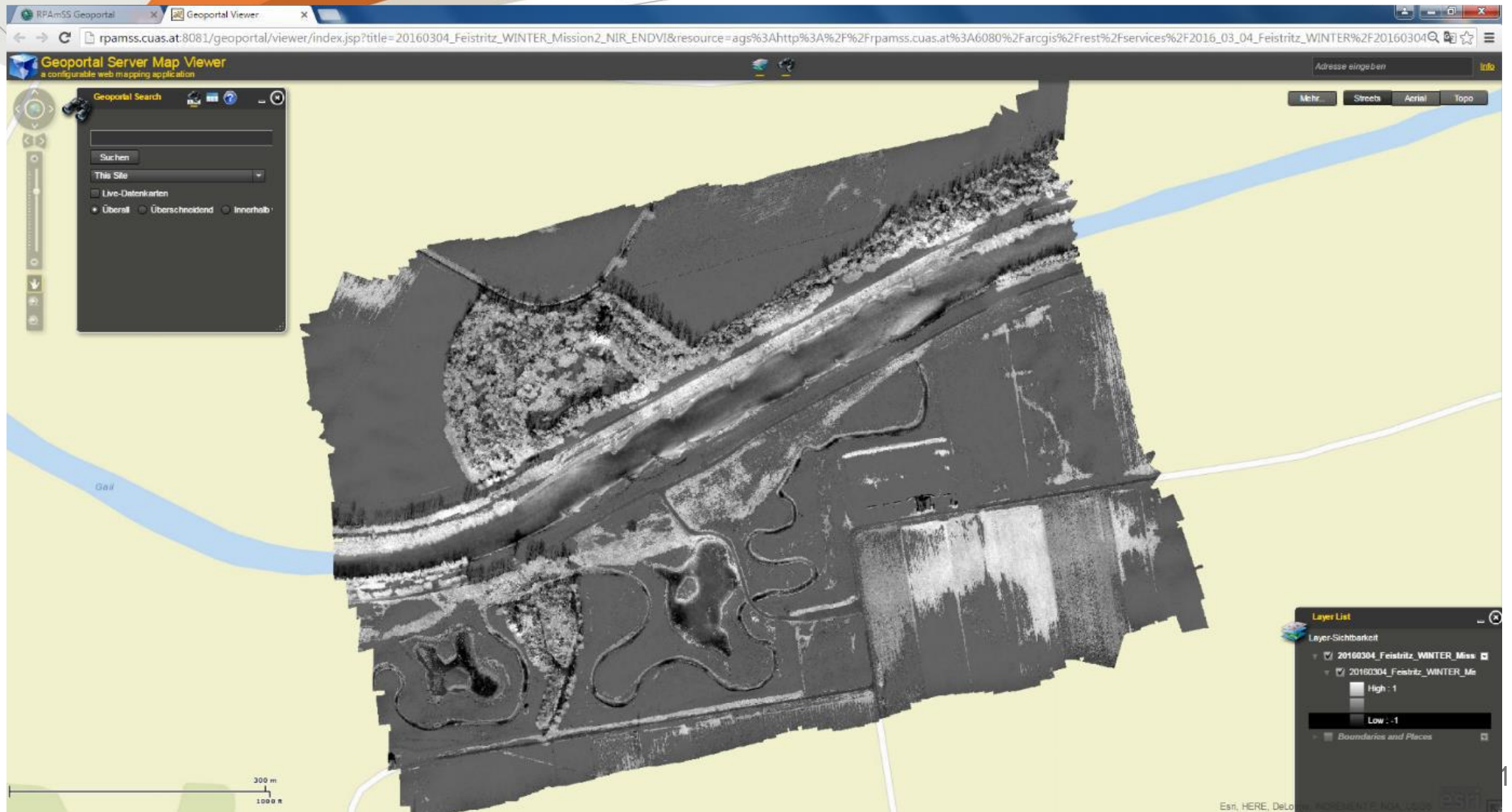
a) All Footprints



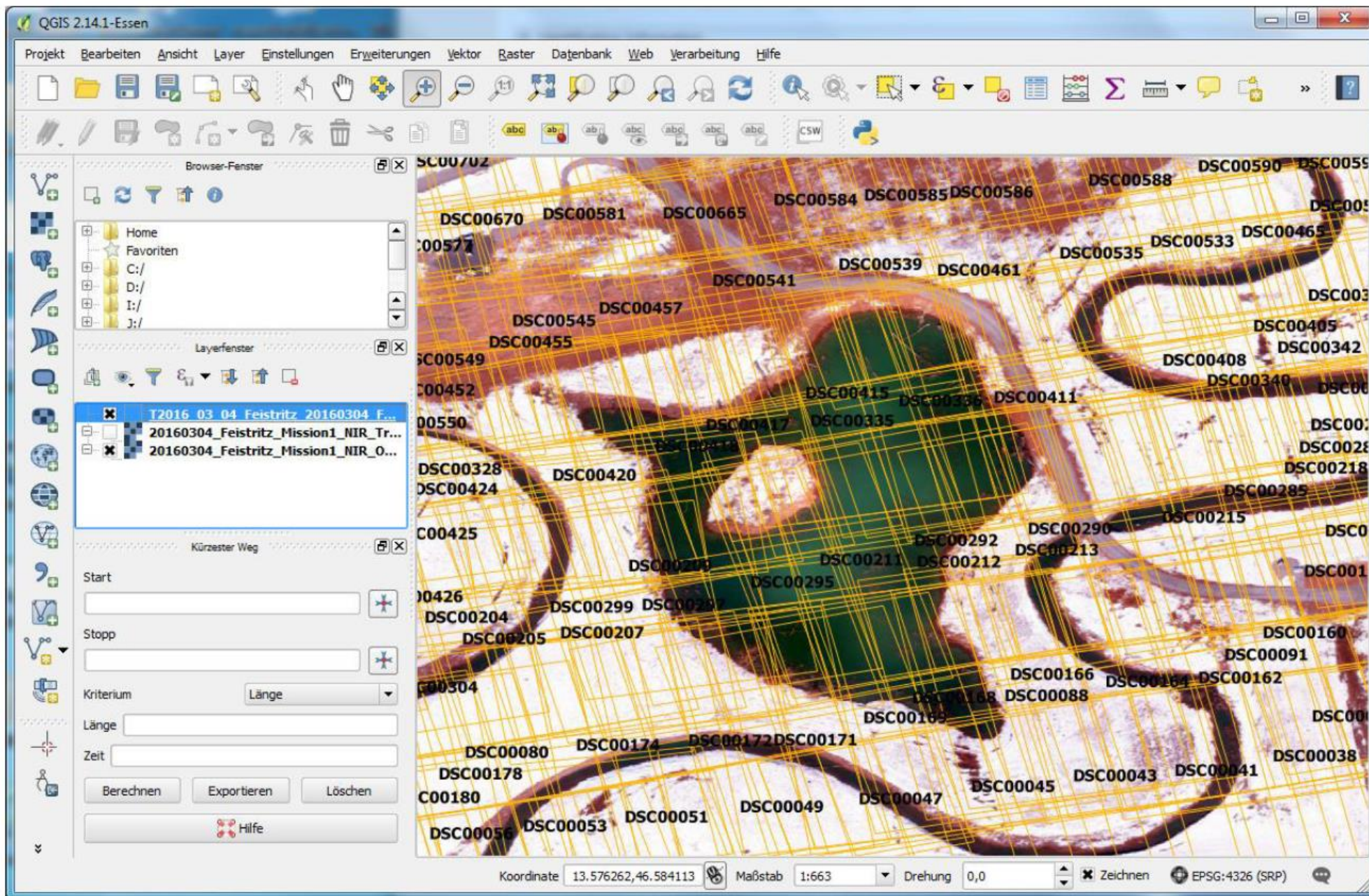
b) Selected Footprints



# Analysis – ENDVI - Example



# UAS Data Integration in QGIS via WMS & WFS Webservices



## Open Issues

- Prototype Implementation for 1 fixed-wing UAS
  - Project driven approach
  - Multiple UAS, e.g. Rotary Wing, Multi-rotor, Hybrid VTOL, LTA,.....?
- No consideration of Reference Data
  - Ground Control Points (GCP)!
  - Ground Truthing e.g. Field measurements
- No consideration of Data Lineage
  - Metadata for Analysis parameters

# Outlook & Future Research – **Public Sector Information Directive 2019**

## **Paragraph 27**

The volume of **research data** generated is growing exponentially and has potential for re-use beyond the scientific community.....

.....**Research data is different from scientific articles** reporting and commenting on findings resulting from their scientific research.....

.....**Open access** helps enhance quality, reduce the need for unnecessary duplication of research, speed up scientific progress, combat scientific fraud, and it can overall favor economic growth and innovation.....

.....to ensure that **data management planning** becomes a **standard scientific practice** and to support the dissemination of research data that are findable, accessible, interoperable and re-usable (the **FAIR principle**).