



University of
Zurich ^{UZH}

Department of Geography

UNIVERSITY OF
WOLLONGONG



RSL

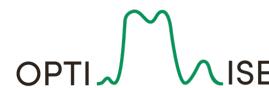
measurements | products | policy

The Spectral Information System SPECCHIO V3.3 - Introduction

Andy Hueni¹

¹ Remote Sensing Laboratories, University of Zurich, Switzerland

Date: 2024 APR



cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY



a+ scnat
swiss academy of sciences



Agenda

- Spectral Information Systems: Raison d'être
- Metadata
- Methods
 - SPECCHIO Architecture
 - Spectroscopy Lifecycle Support
- Results



Spectral Information Systems: Raison d'être



Spectral Information Systems are systems for **building** and **providing spectral information**, utilising spectral databases as repositories for **spectral data** and associated **metadata**.

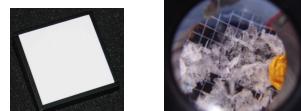


Common Issues in Field Spectroscopy

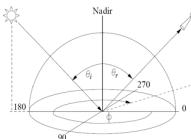
Where are my data files?



... and there are thousands of them: how to keep track?



What were the sampling context and conditions?



My instrument is not
producing the truth?!?

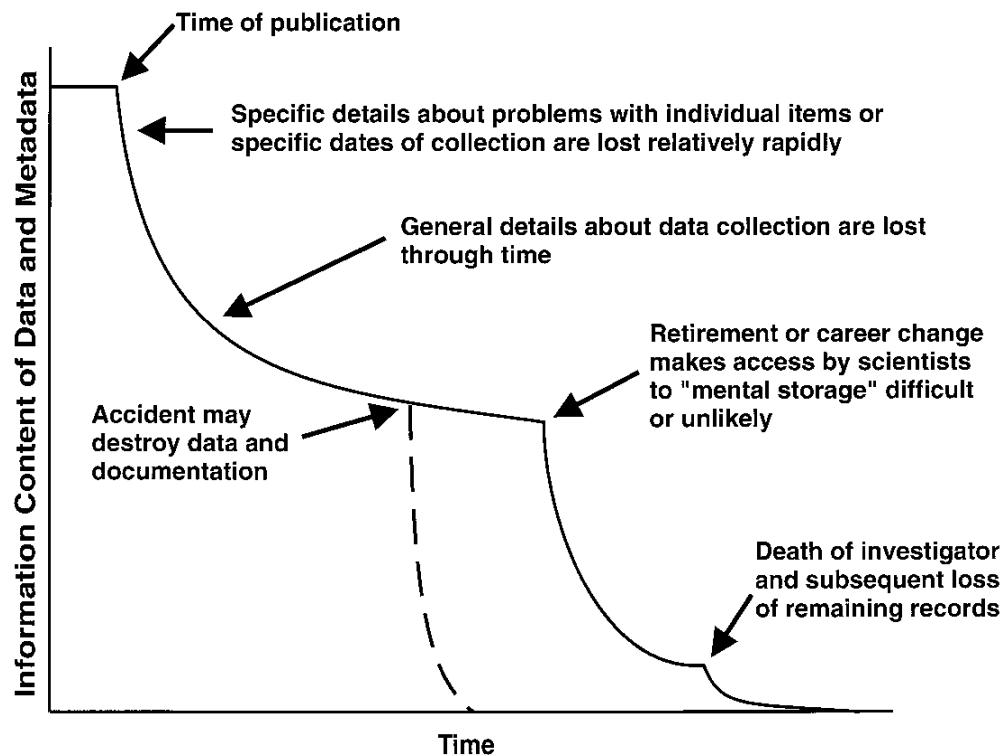


Can someone else make use of my data?





On the Importance of Metadata

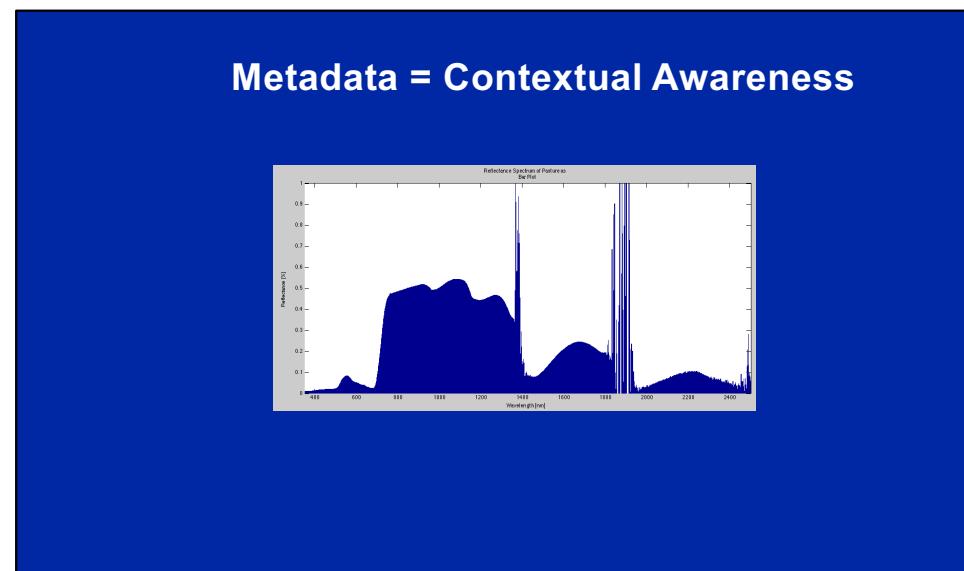


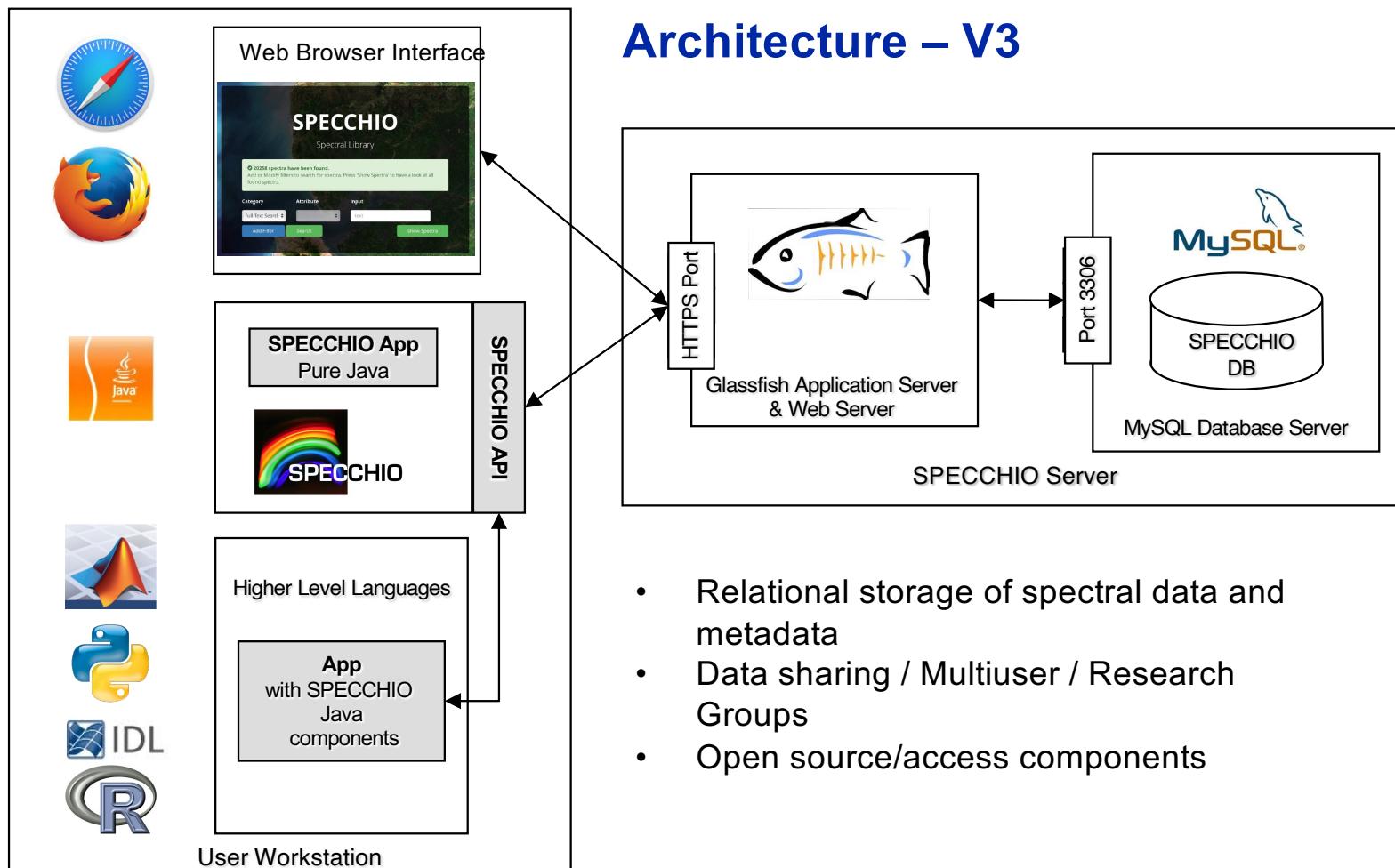
W. K. Michener, J. W. Brunt, J. J. Helly, T. B. Kirchner, and S. G. Stafford,
"NONGEOSPATIAL METADATA FOR THE ECOLOGICAL SCIENCES," *Ecological Applications*, vol. 7, pp. 330–342, 1997.



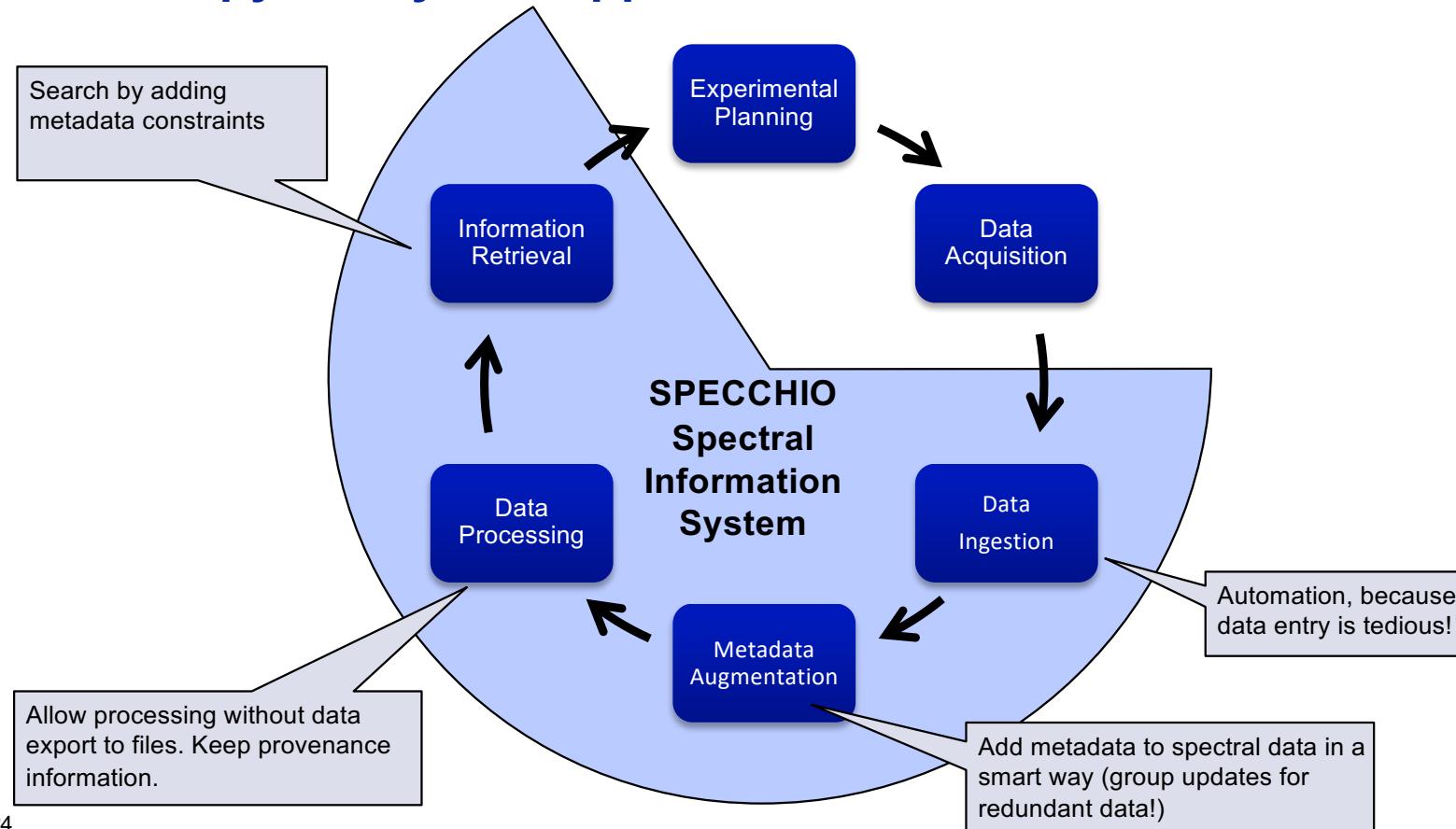
Methods

SPECCHIO Spectral Information System



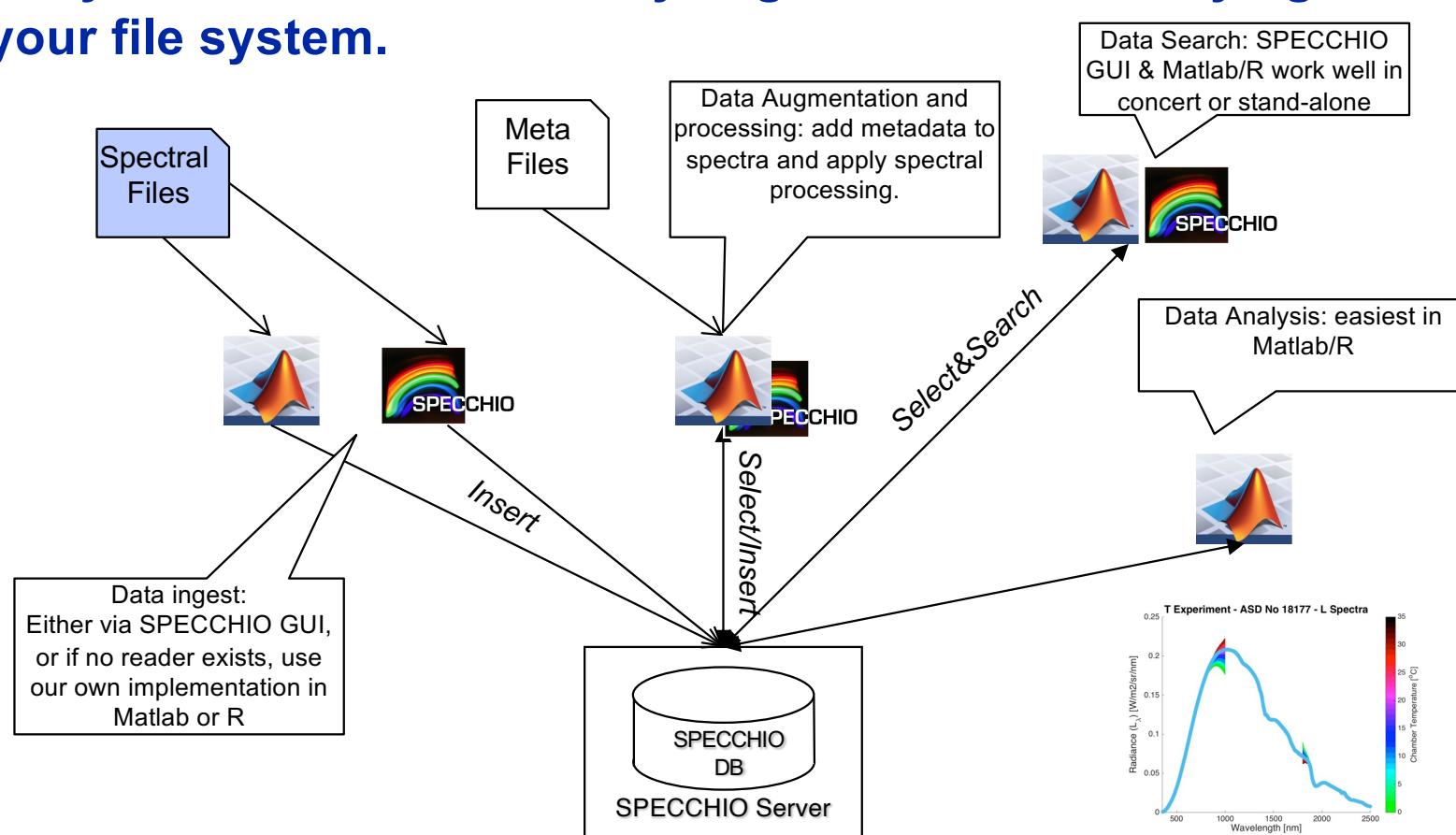


Spectroscopy Lifecycle Support





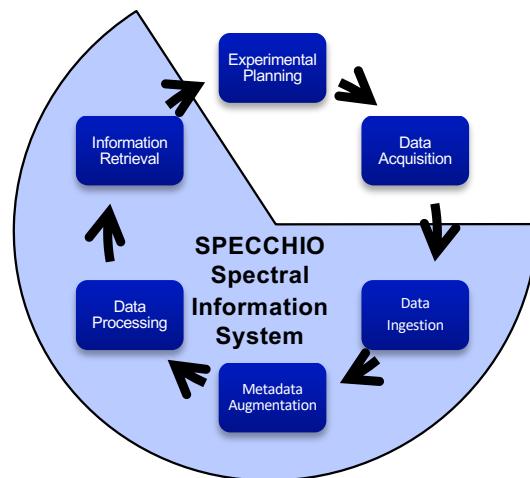
Spend your research time analysing data instead of trying to find it on your file system.





Results

Practical Use



Installation/Availability

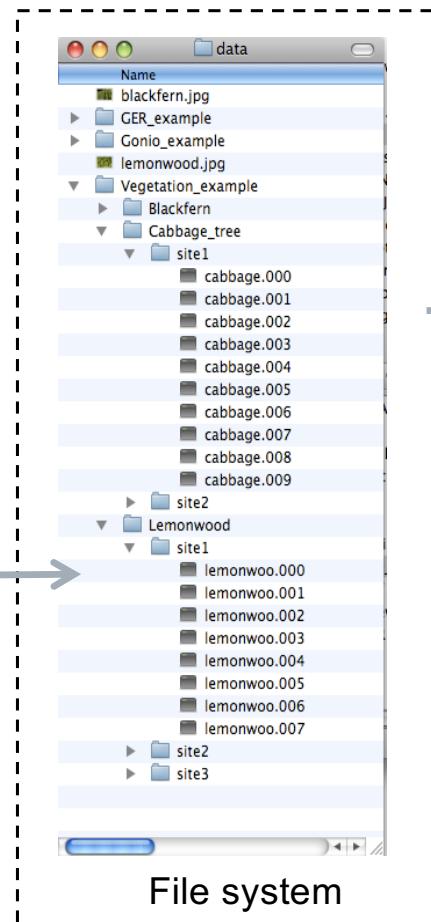




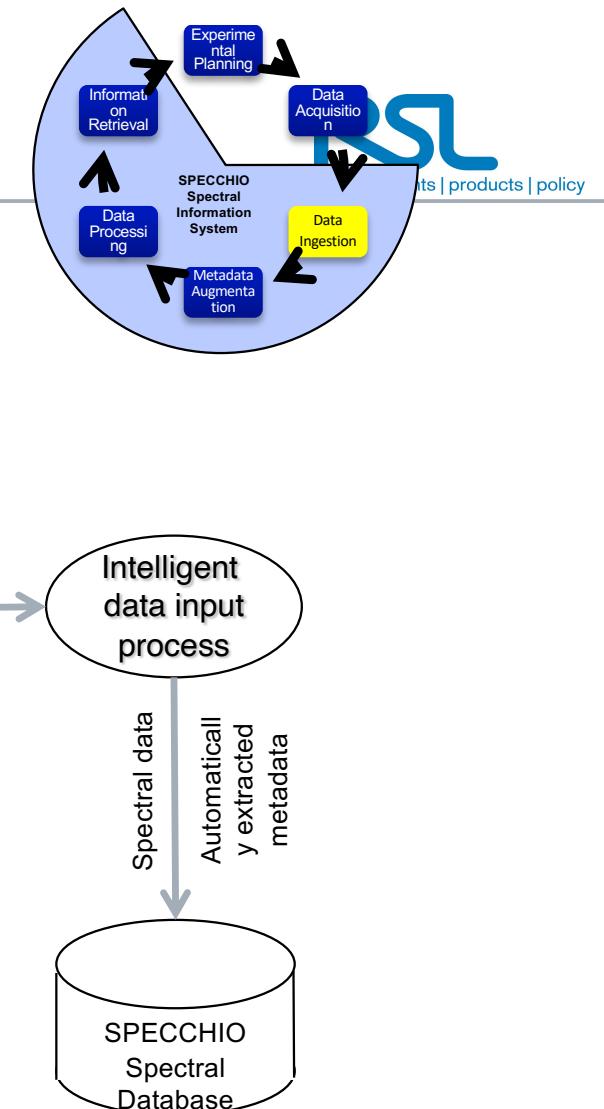
Concepts - Data Input



Spectral files
&
user defined structures



File system





Metadata Augmentation

Metadata Editor V3

Do conflict detection Sampling Date

Order by: Sampling Date

- SG_t1_Grassland
- SG_t2_Grassland
- SG_t3_Grassland
- MM015_BASEL_100625_spectra
- MM016_ZRH__100626_spectra
- MM017_LAEGE_100626_spectra
- MM020_OENS_100626_spectra
- MM026_LAEGE_100629_spectra
- s1_t1_Lawn
- s2_t1_Sand (Fine)
- s3_t1_Roof (Black rubber)
- s4_t1_Tartan (Orange)
- s5_t1_River
- s6_t1_Tennis Court (Sand)
- Radiance
- Radiance Jump Corrected
- Reflectance
 - W_6.005
 - W_6.006
 - W_6.007
 - W_6.008
 - W_6.009
 - W_6.010
 - W_6.011
 - W_6.012
 - W_6.013
 - W_6.014
 - W_6.015
 - W_6.016
 - W_6.017
 - W_6.018
 - W_6.019
- s7_t1_Asphalt
- MM029_OENS_110615_spectra
- MM031_CHNP_110626_spectra
- MM034_ZRH_110626_spectra

Refresh Update Reset

Campaign Metadata

Altitude [m] 390.0
Latitude [Degrees] 47.46471
Longitude [Degrees] 8.31583
Waypoint ID W6

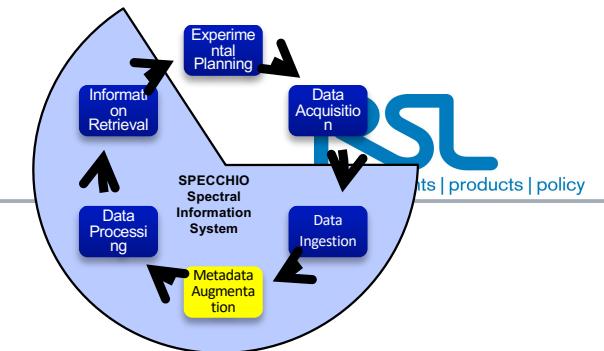
Optics
FOV [Degrees] 25

Pictures
Sampling Setup Picture
Target Picture

Processing
Processing Algorithm ASD Jump Correction by temperature
Reflectance calculation in Matlab

Associated Campaigns
Campaign Details
Data Links
Data Portal
Environmental Conditions
General
Generic Target Properties
Geochemistry
Illumination
Instrument
Instrument Settings
Instrumentation
Keywords
Location
Names
Optics
PDFs
Personnel
Pictures
Processing
Sampling Geometry
Sampling Scheme
Scientific References
Soil Parameters
Vegetation Biophysical Variables

Select All
Select None
App. Domain: ---



- Group updates
- Conflict detection
- Application domain categories
- Automatic inserts:
 - Altitude
 - Measurement support
 - Solar angles
 - Goniometer Angles



Metadata Augmentation from XLS

- Auto-matching to existing metadata in DB

Metadata Augmentation from Tabular Data

REGEX

REGEX start
REGEX end
REGEX example: 15A.*

Element - Column Auto-Matching

Matching File: Mappings of columns for Lolas Leafs.xls

Apply Auto-Matching

Assignment Details

Number of assignable columns: 12
Number of assigned columns: 6

Matching Details

Number of spectra: 32
Number of matches: 24

Spectrum ...	DB Value	Table Value
248	15A.001	15A
249	15A.002	15A
250	15A.003	15A
251	15A.004	15A
252	15B.001	15B
253	15B.002	15B
254	15B.003	15B
255	15B.004	15B
256	3A.001	3A
257	3A.002	3A
258	3A.003	3A
259	3A.004	3A
260	3B.001	
261	3B.002	
262	3B.003	
263	3B.004	

Matching & Element Assignment Control

Matching Column: NIL
General: Associated Campaigns
File Name: NIL

tree	spp	Neoxanthin
15A	peach	7.908
15B	peach	9.97
3A	peach	9.868
5A	peach	9.415
5B	peach	7.596
8B	peach	8.134

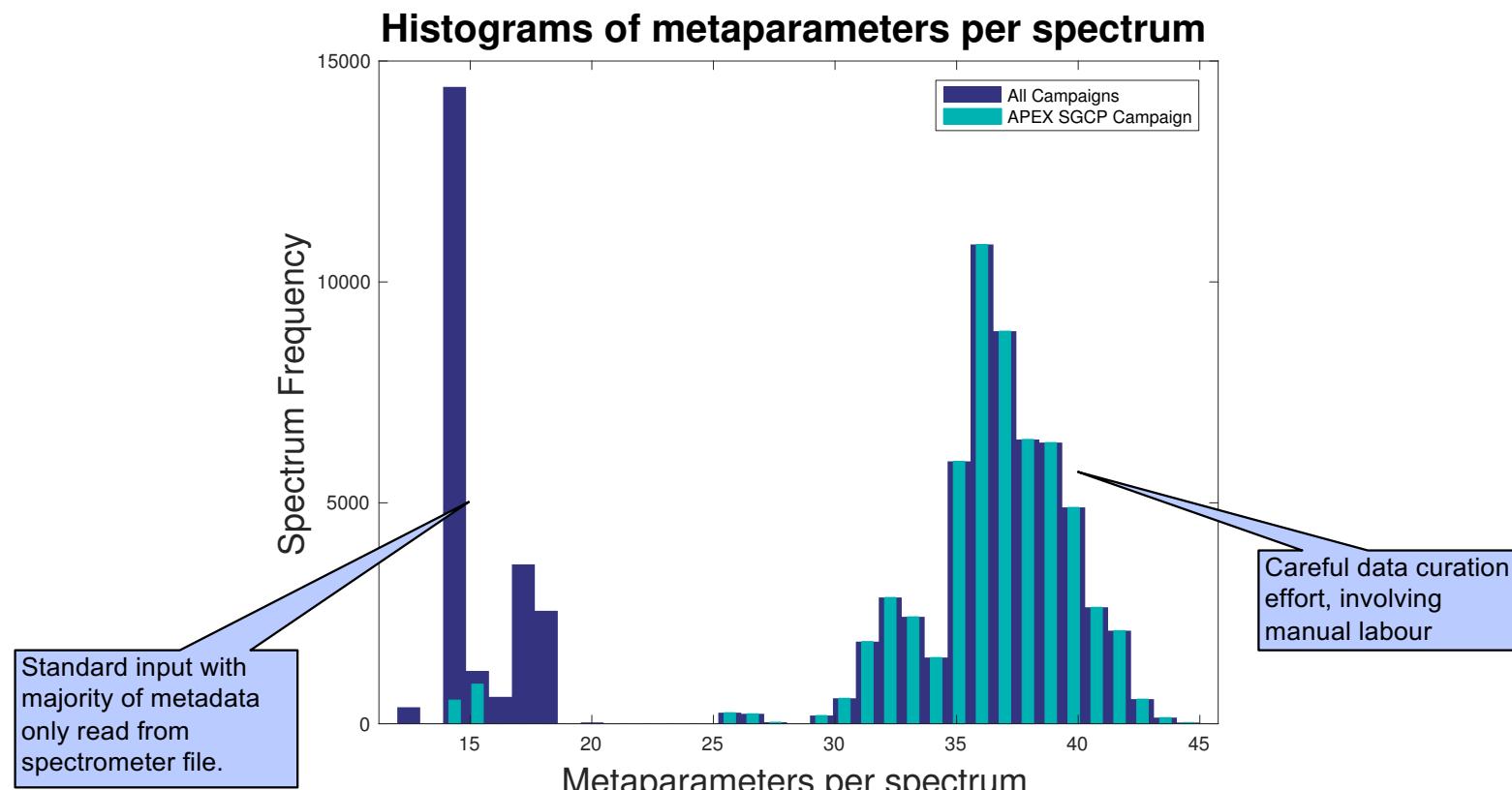
Order by: Sampling Date

Refresh

Insert Selected Metadata



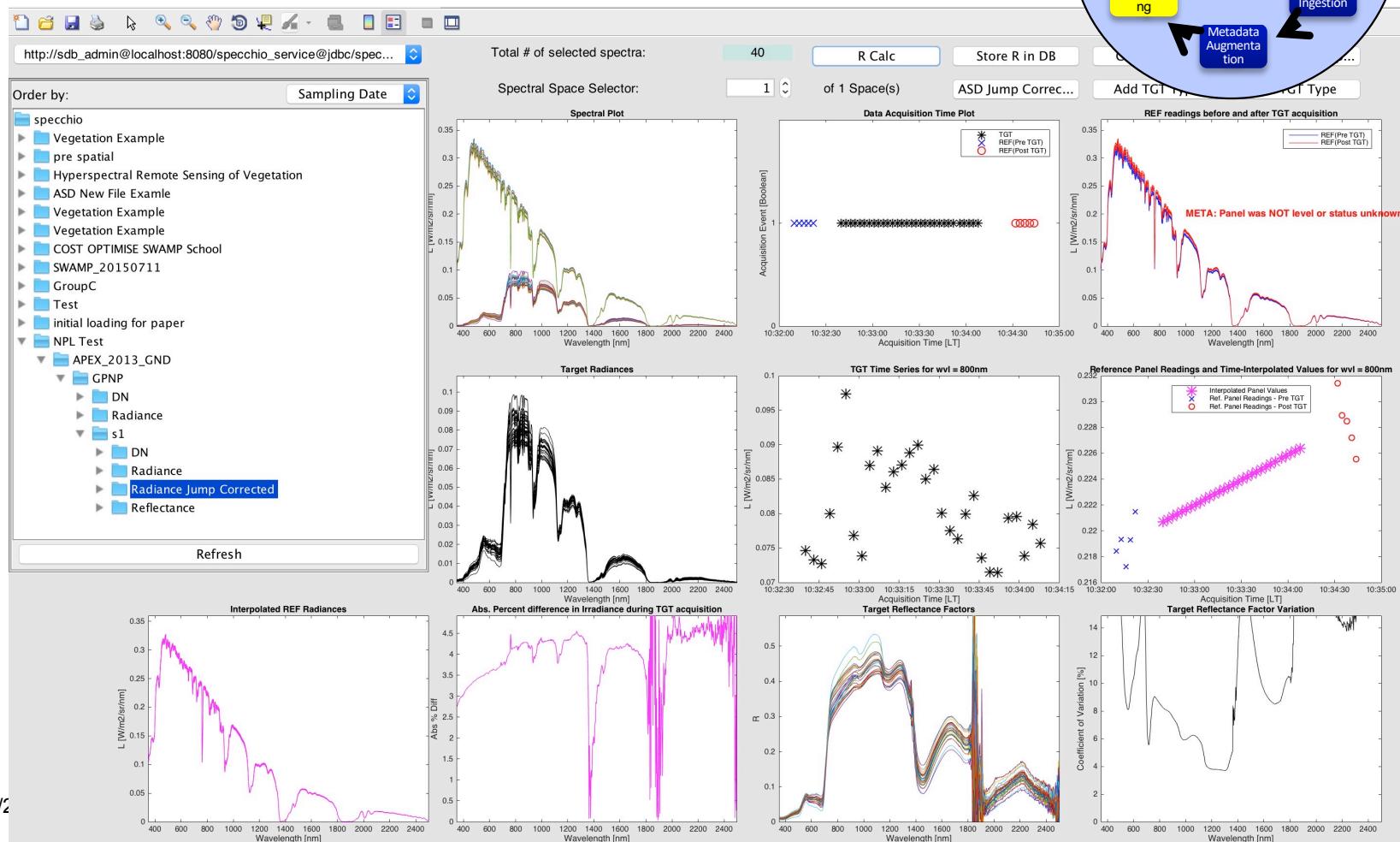
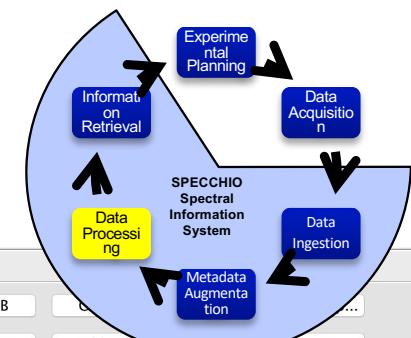
Even with Automation, Metadata Entry takes Time!





Spectral Processing: Reflectance Calculation

Interactive processing: jump-corrected radiances to reflectance factors using linear irradiance estimation. Reflectance factors are inserted into the SPECCHIO database, linking with all previously entered metadata





Data Selection

Interactive Query Building

Query Builder (V3)

Query conditions

Dry Weight	-	-
EPS	-	-
Height	-	-
Leaf Area	-	-
Lutein	0.001	- 5
Neoxanthin	-	-
Specific Leaf Area	-	-
Violaxanthin	1	- 4
Water Content	-	-
Wet Weight	-	-

Run Query

Matching Spectra:
280, 281, 282, 283, 310, 311, 312, 313, 305, 306, 307, 308, 296, 297, 298, 299, 359, 360, 361, 362, 383, 384, 385, 386

Number of results: 24

Show report File export Spectral Plot
Process Refl.Calc Publish Collection

Splitting rules for file export and plotting:
 Split spaces by sensor
 Split spaces by sensor and unit
 Split spaces by sensor, instrument, calibr_no and unit

Autogenerated query
code, for use in Matlab or
R:

4/13/24

```
cond = EAVQueryConditionObject('eav', 'spectrum_x_eav', 'Lutein', 'double_val');
```

```
cond.setValue('0.001');
```

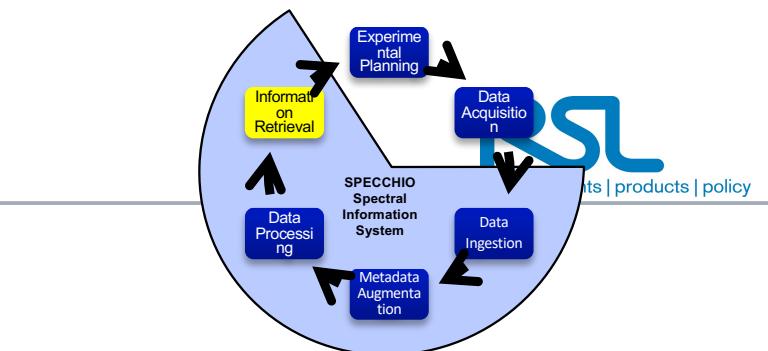
```
cond.setOperator('>=');
```

```
query.add_condition(cond);
```

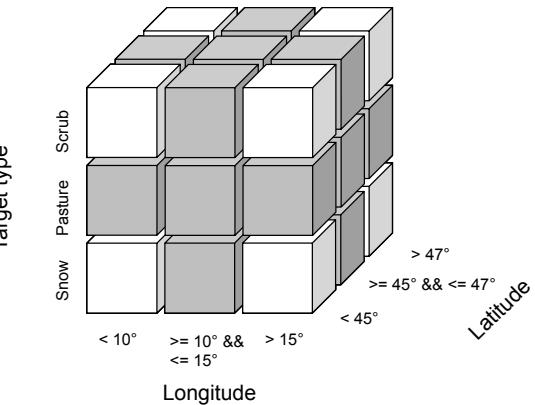
```
cond = EAVQueryConditionObject('eav', 'spectrum_x_eav', 'Lutein', 'double_val');
```

```
cond.setValue('5.0');
```

```
cond.setOperator('<=');
```

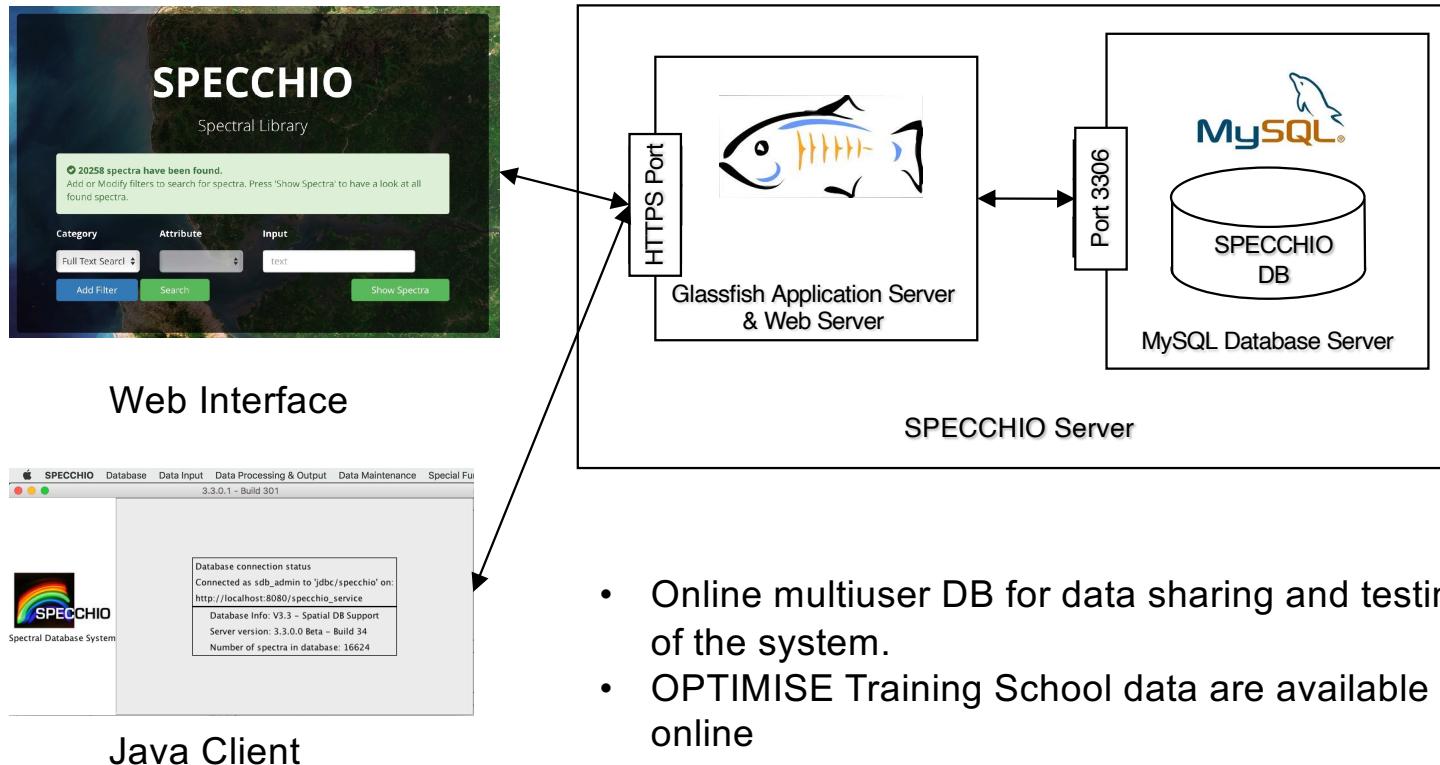


Metadata space restrictions





Availability and Installation: Online System





Availability and Installation: Desktop Client

The screenshot shows the SPECCHIO desktop application window. At the top, it displays "SPECCHIO Database Data Input Data Processing & Output Data Maintenance Special Fu" and "3.3.0.1 - Build 301". Below this is a "Database connection status" section showing "Connected as sdb_admin to 'jdbc/specchio' on: http://localhost:8080/specchio_service Metadata Editor v3". The main area contains a "Sampling Date" dropdown set to "Sampling Date" and a "Do conflict detection" checkbox checked. On the left is a tree view of spectra files, including entries like "SG_11_Grassland", "SG_12_Grassland", "SG_13_Grassland", and "S1_1_Lawn". In the center, there's a "Campaign" tab selected, showing "Altitude [m] 390.0", "Latitude [Degrees] 47.46471", "Longitude [Degrees] 8.31583", "Waypoint ID W6", and "FOV [Degrees] 25". To the right is a "Metadata" tab with various checked options such as "Associated Campaigns", "Campaign Details", "Data Links", "Environmental Conditions", "General", "Generic Target Properties", "Geochemistry", "Illumination", "Instrument", "Instrument Settings", "Instrumentation", "Keywords", "Location", "Names", "Optics", "PDFs", "Personnel", "Pictures", "Processing", "Sampling Geometry", "Sampling Scheme", "Scientific References", "Soil Parameters", and "Vegetation Biophysical Variables". At the bottom, there are buttons for "Select All", "Select None", and "App. Domain: ---".

- Java
- Runs on macOS, Linux, Windows, etc
- GUI
- Connection to any open access SPECCHIO database



SPECCHIO



Availability and Installation: SPECCHIO Virtual Machine

The screenshot displays the SPECCHIO software environment running on a Mac OS X desktop. The desktop icons include Computer, root's Home, Trash, SPECCHIO Client, and SPECCHIO Software Update. The application windows are:

- Data Input:** Shows a database connection status to 'specchio' on 'http://SPECCHIOVM.specchio.ch:8080/specchio_service'. It lists 'Database Info' and 'Number of spectra in database: 64'.
- Metadata Editor V3:** A campaign-based metadata editor. A 'Blackfern' campaign is selected, showing details like Latitude [Degrees]: 40.38469166666667 and Longitude [Degrees]: 175.62149666666667. Other sections include Names, Optics (FOV [Degrees]: 25), PDFs, Personnel, and Pictures (Target Picture showing a close-up of a fern leaf).
- Data Browser (V3):** A tree-view browser showing the structure of the data. It includes sections for 'Visualisations' (Matching Spectra) and 'Browser' (specchio, SPECCHIO Tutorial, specchio_example, Cabbage_tree, Lemonwood). A 'Spectral Plot' window is overlaid on the browser, showing multiple spectra curves against Wavelength [nm] from 0.4 to 2.6.
- SPECCHIO Web Interface - Mozilla Firefox:** A web browser window showing the SPECCHIO Web Interface. It displays a search results page for 'blackfern' with 34 spectra found. The interface includes a search bar, category and attribute dropdowns, and a 'Show Spectra' button. Below the search results is a satellite image of a coastal area with the SPECCHIO logo overlaid.

The bottom of the screen shows the Mac OS X dock with various application icons.



Availability and Installation: Open Source



All SPECCHIO code (client and server) is open source and can be found on GitHub:
<https://github.com/SPECCHIODB/SPECCHIO>

The screenshot shows the GitHub repository page for `ahueni / SPECCHIO`. The repository has 785 commits, 1 branch, 25 releases, and 4 contributors. Recent commits include:

- `ahueni`: Bug fix for a metadata insert issue (e.g. in UTC computation) - 2 days ago
- `conf`: Bug fixes in schema for MySQL 5.7 - 14 days ago
- `doc`: V3.2.1.6 - 13 days ago
- `pkg`: Bug fix for a metadata insert issue (e.g. in UTC computation) - 2 days ago
- `src`: Moving away from Campaign Factory abstraction. - 7 days ago
- `web`: Fixed the file sizes on the web page. - 3 years ago
- `LICENCE.html`: Added licensing information. - 4 years ago
- `README`: Add link to DC10 Project GitHub page. - 2 years ago



SPECCHIO over Time – The only constant is change					
2002		V0	RSL Internal	Bojinski, S., Schaepman, M., Schlaepfer, D. and Itten, K. (2002). "SPECCHIO: a Web-accessible database for the administration and storage of heterogeneous spectral data." <i>Photogrammetry and Remote Sensing</i> 57 : 204-211.	
2006		V1	 Online DB	Hueni, A., Nieke, J., Schopfer, J., Kneubühler, M. and Itten, K. (2009). "The spectral database SPECCHIO for improved long term usability and data sharing." <i>Computers & Geosciences</i> 35 (3): 557-565.	
2009		V2	 Exchange More metadata	Hueni, A., Malthus, T., Kneubuehler, M., Schaepman, M., 2011. Data Exchange between distributed Spectral Databases. <i>Computers & Geosciences</i> 37 , 861-873.	
2012		V3	 Generic metadat a	Hueni, A., Chisholm, L., Suarez, L., Ong, C. and Wyatt, M. (2012). Spectral Information System Development for Australia. <i>Geospatial Science Research Symposium. Melbourne, Australia.</i> 1328 : 1-11.	
2015		V3.2	SPECCHIO Virtual Machine, SPECCHIO API public, Programming Courses		
2015		V3.2.1	Operational upgrades	Bertschi, S. and Hueni, A. (2017). Applied Spectral Databases - APEX Spectral Ground Control Point Handling. <i>10th EARSeL SIG Imaging Spectroscopy Workshop. Zurich, CH.</i>	
2017		V3.3	Spatial database support		



SPECCHIO over Time – The only constant is change

2020	 V3.3.0	Hierarchy level metadata. Speed-ups.
2023	 V3.3.0	Uncertainty Support

Hueni, A., Chisholm, L., Ong, C., Malthus, T., Wyatt, M., Trim, S., A., Schaepman, M. E. and Thankappan, M. (2020). "The SPECCHIO Spectral Information System." *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* **13**: 5789-5799.

Hueni, A., Mason, K. and Trim, S. (2023). "Uncertainty Support in the Spectral Information System SPECCHIO." *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* **16**: 2668-2680.



SPECCHIO tutorial: learn how to use the SPECCHIO GUI

[SPECCHIO](#) [Tutorial](#)



Tutorial

https://specchiodb.github.io/Guides/SPECCHIO_Tutorial.pdf

Version: 3.3.0.0
Date: 17.09.2019
Status: Approved
Authors: P. Roberts (Intersect), A. Hueni & D. Kuekenbrink (Remote Sensing Laboratories, University of Zurich)
File: SPECCHIO_Tutorial.docx
Pages: 38

Classification:
Distribution: SPECCHIO Users





University of
Zurich ^{UZH}

Department of Geography

RSL
measurements | products | policy

Thank you for your attention!

For more information on the current version of SPECCHIO see: www.specchio.ch

https://twitter.com/SPECCHIO_DB 

