



# The Spaceborne Imaging Spectrometer DESIS: Data Access, Outreach Activities, and Scientific Applications

Daniele Cerra<sup>(1)</sup>, David Marshall<sup>(2)</sup>, Uta Heiden<sup>(1)</sup>, Kevin Alonso<sup>(1)</sup>, Martin Bachmann<sup>(2)</sup>, Kara Burch<sup>(3)</sup>, Emiliano Carmona<sup>(1)</sup>,  
Daniele Dietrich<sup>(2)</sup>, Heath Lester<sup>(4)</sup>, Uwe Knodt<sup>(5)</sup>, David Krutz<sup>(6)</sup>, Rupert Müller<sup>(1)</sup>, Raquel de los Reyes<sup>(1)</sup>, Peter Reinartz<sup>(1)</sup>, Mirco Tegler<sup>(2)</sup>

- (1) DLR German Aerospace Center, Remote sensing Technology Institute, Oberpfaffenhofen, Germany
- (2) DLR German Aerospace Center, German Remote Sensing Data Center, Oberpfaffenhofen , Germany
- (3) I2R Innovative Imaging and Research Corp, Stennis Space Center, USA
- (4) Teledyne Brown Engineering, Huntsville, Alabama, USA
- (5) DLR German Aerospace Center, DLR Headquarters, Cologne , Germany
- (6) DLR German Aerospace Center, Institute of Optical Sensors, Berlin-Adlershof , Germany




Knowledge for Tomorrow



For an introduction to DESIS and information about DESIS vicarious calibration check **Emiliano Carmona's** contribution:

MO7.V20.3 - **Vicarious Calibration of the DESIS Imaging Spectrometer: Status and Plans**

Streamed Monday, 18 July, 15:45 - 16:00 UTC



# Content

- DESIS products & data access for scientific purposes
- 1st DESIS User Workshop summary (September 2021)
- DESIS Scientific Applications & CHIME Preparatory Activities



# DESIS – Data products + Data quality



## Archive

L1A Raw Data  
(prepared for selection & ordering & processing)

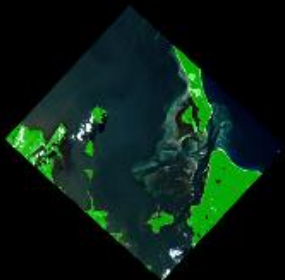
## Analysis Ready Data

L1B Top-Of-Atmosphere (TOA) Radiance

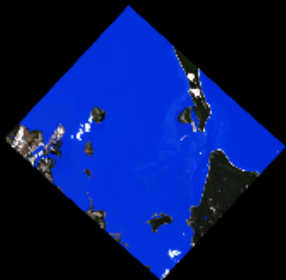
L1C Geocoded & Orthorectified

L2A Bottom-of-Atmosphere (BOA) Reflectance

Land Mask



Water Mask



Cloud Mask



Cloud Shadow  
over land



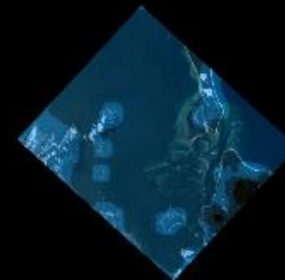
Haze over land



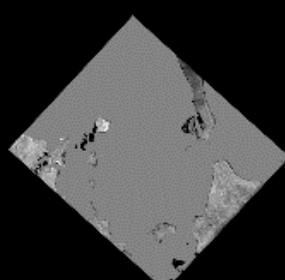
Haze over  
water



AOT Map



WV Map



# DESIS Data Access – Access the Archive or Task the Sensor!

Order archived data

DLR – Science Coordination  
[desis-scientific@dlr.de](mailto:desis-scientific@dlr.de)

Specific  
DESIS Access  
(EOWEB)

Contact

User

Searching  
Processing

EOWEB Portal  
(DLR)

Download

Data transfer (L1B, L1C, L2A)

Tasking new DESIS data

DLR – Science Coordination  
[desis-scientific@dlr.de](mailto:desis-scientific@dlr.de)

Proposal  
Acceptance  
+  
Specific  
DESIS Access  
(TCloud /  
EOWEB)

Proposal  
Submission

User

Tasking

TCloud Portal  
(TBE)

Automated  
data transfer  
of L1A

Searching  
Processing

EOWEB Portal  
(DLR)

Download

Data transfer (L1B, L1C, L2A)



# DEGIS data can be searched and downloaded through EOWEB GeoPortal

Filter Management Filter: Region Collections Clear Filters Hide Filter Gallery

**Filter by Region**

Show Advanced Map

**Filter by Time**

Starttime: 1970-01-01 00:00:00  
Endtime: 2021-09-24 23:59:00  
Choose a range

**Filter by Collection**

- ISX-1 Experimental Products
- TanDEM-X
- IRS
- Thematic Maps
- FireBIRD
- TanDEM-X Pursuit TSX-1 Like
- TanDEM-X Pursuit TSX-1 Like Experimental
- DEGIS

Search

0 of 20 results selected

Toggle View



Show items: 20

Go to: 1 / 2

1 DEGIS.HSIL1A 2021-08-17T06:17:12.104Z - 2021-08-17T06:17:16.451Z	2 DEGIS.HSIL1A 2021-08-17T06:17:07.755Z - 2021-08-17T06:17:12.101Z	3 DEGIS.HSIL1A 2021-08-09T09:22:18.201Z - 2021-08-09T09:22:22.547Z	4 DEGIS.HSIL1A 2021-08-05T10:54:51.099Z - 2021-08-05T10:54:55.445Z	5 DEGIS.HSIL1A 2021-08-05T10:54:46.750Z - 2021-08-05T10:54:51.095Z	6 DEGIS.HSIL1A 2021-06-06T10:48:36.954Z - 2021-06-06T10:48:41.301Z	7 DEGIS.HSIL1A 2021-06-06T10:48:32.605Z - 2021-06-06T10:48:36.950Z	8 DEGIS.HSIL1A 2021-06-02T12:21:24.077Z - 2021-06-02T12:21:28.423Z	9 DEGIS.HSIL1A 2021-06-02T12:21:19.727Z - 2021-06-02T12:21:24.074Z
10 DEGIS.HSIL1A 2020-10-17T12:58:29.666Z - 2020-10-17T12:58:34.012Z	11 DEGIS.HSIL1A 2020-10-17T12:58:25.317Z - 2020-10-17T12:58:29.661Z	12 DEGIS.HSIL1A 2020-10-13T08:02:36.880Z - 2020-10-13T08:02:41.226Z	13 DEGIS.HSIL1A 2020-10-13T08:02:32.531Z - 2020-10-13T08:02:36.878Z	14 DEGIS.HSIL1A 2020-10-09T09:36:42.090Z - 2020-10-09T09:36:46.436Z	15 DEGIS.HSIL1A 2020-10-09T09:36:37.740Z - 2020-10-09T09:36:42.086Z	16 DEGIS.HSIL1A 2020-10-01T12:42:15.773Z - 2020-10-01T12:42:20.118Z	17 DEGIS.HSIL1A 2020-10-01T12:42:11.422Z - 2020-10-01T12:42:15.769Z	18 DEGIS.HSIL1A 2020-08-11T08:54:06.059Z - 2020-08-11T08:54:10.405Z

# Status of Data Acquisitions (June 2022)



## World

~130.400 scenes processed (archive)

<79% of Earth surface (land)

~64 TB data in the archive

Note: DESIS is not a mapping mission

# Current scientific applications of DESIS (2022)

~70 international teams are using DLR's science access to DESIS data  
(plus additional commercial customers of TBE)

Topic	Number of proposals
Urban Thematic Exploitation & Material Composition	2
Landcover & vegetation	9
Water Resources	9
Ocean Applications	5
Coastal Applications	8
Calibration	1
Natural Resources	10
Geology	8
Biodiversity	2
Others (e.g. methods development, data fusion)	4

22 proposals  
related to water applications

*Spectral range 400 – 1000 nm*





# 1st DESIS User Workshop

September 28<sup>th</sup> to October 1<sup>st</sup>, 2021

Virtual event



## Statistics

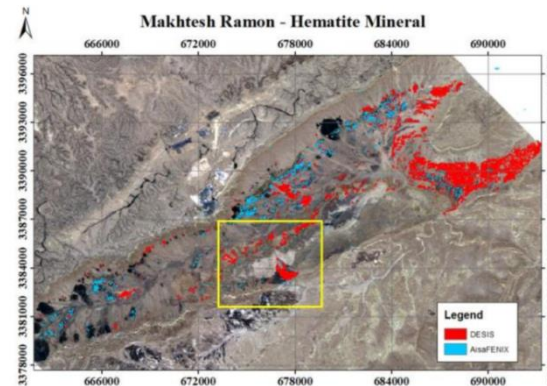
- 235 registrations
- 30 nations
- 53 presentations
- 13 full paper submissions (ISPRS)

## Events

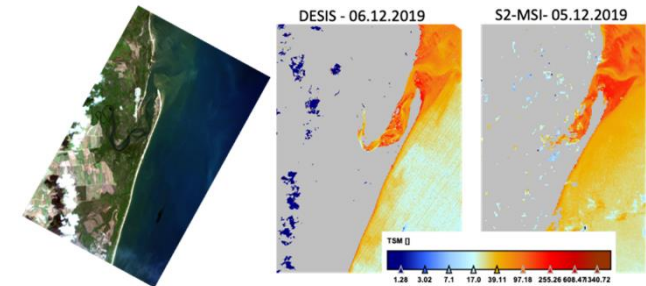
- 10 sessions on 4 days
- Chats with the DESIS team
- **Next: best DESIS Image Award!**



## DESIIS Workshop publication The International Archives of the ISPRS



Heller Pearlshien, D. and Ben-Dor, E.:  
*CALVAL EVALUATION OF DESIS PRODUCTS  
IN AMIAZ PLAIN AND MAKHTESH RAMON  
TEST SITES, SOUTHERN ISRAEL*, Int. Arch.  
Photogramm. Remote Sens. Spatial Inf. Sci.,  
XLVI-1/W1-2021, 13–21,  
[https://doi.org/10.5194/isprs-archives-  
XLVI-1-W1-2021-13-2022](https://doi.org/10.5194/isprs-archives-XLVI-1-W1-2021-13-2022), 2022



Soppa, M. A., Dinh, D. A., Silva, B., Steinmetz, F.,  
Alvarado, L., and Bracher, A.:  
*INTERCOMPARISON OF DESIS, SENTINEL-2 (MSI)  
AND SENTINEL-3 (OLCI) DATA FOR WATER  
COLOUR APPLICATIONS*, Int. Arch. Photogramm.  
Remote Sens. Spatial Inf. Sci., XLVI-1/W1-2021,  
69–72, [https://doi.org/10.5194/isprs-archives-  
XLVI-1-W1-2021-69-2022](https://doi.org/10.5194/isprs-archives-XLVI-1-W1-2021-69-2022), 2022.

## Best DESIS Image Award: top 3

Claudia Giardino et al.,  
CNR, Italy

Lake Trasimeno, a shallow  
turbid Italian lake

Pseudo true color image  
spotting particle patterns  
and a blue spot colonized  
by macrophytes



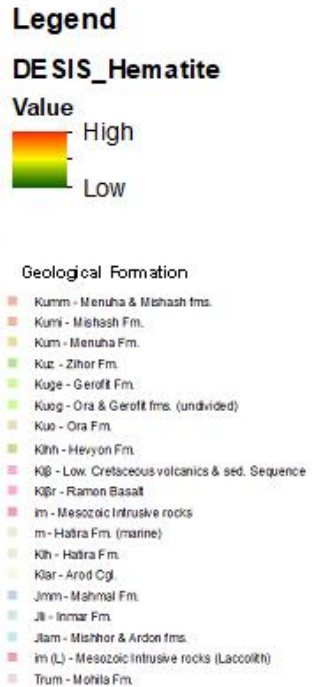
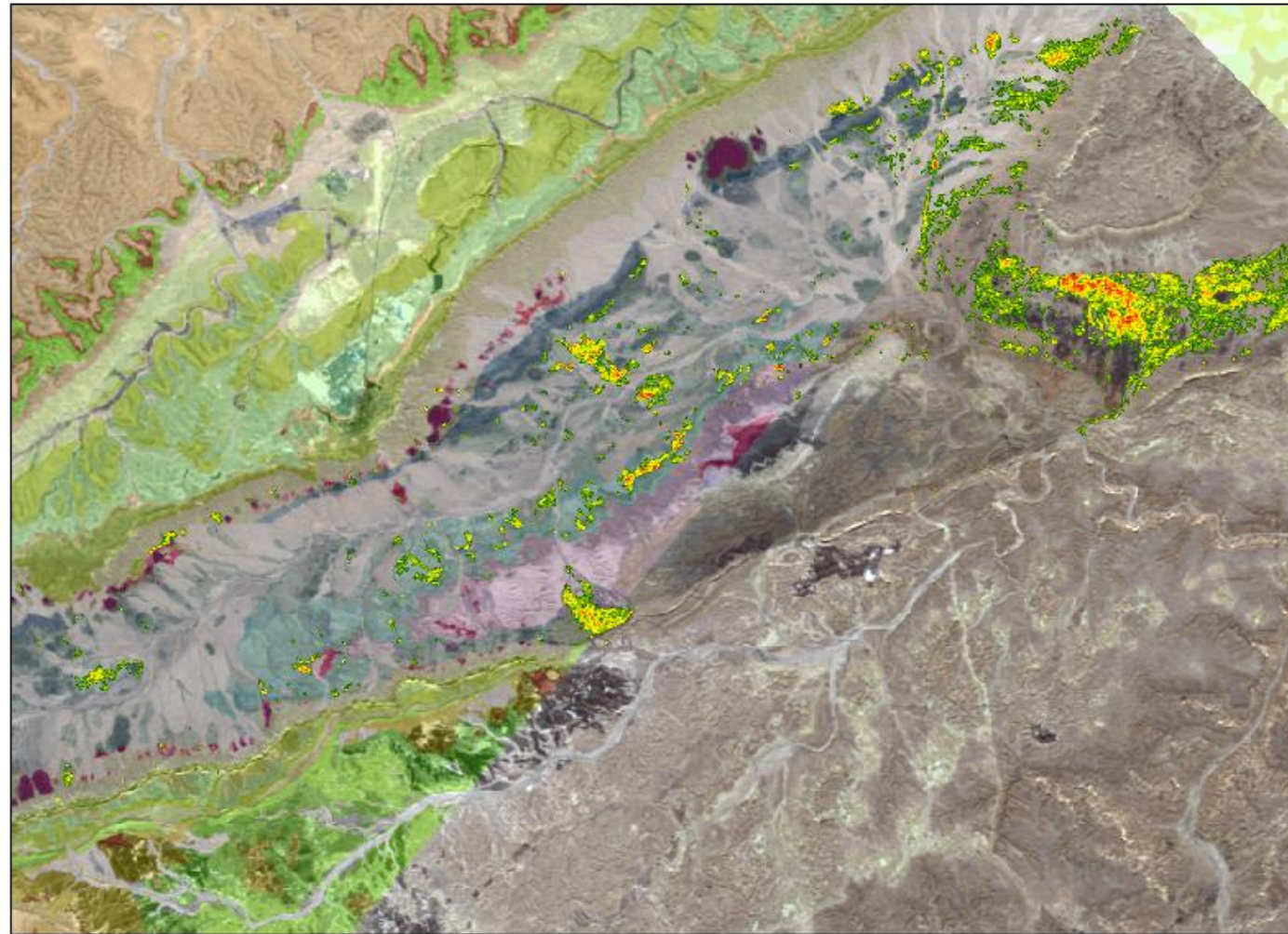
## Best DESIS Image Award: top 3

## DESIS Makhtesh Ramon - Hematite Mineral

Daniela Heller Pearlshtien, Tel Aviv University, Israel

Iron oxide minerals mapped over Makhtesh Ramon, Israel using DESIS (24.02.2021)

Matched filter methods applied (Boardman, 1993)



Center Cord:  
30°35'58.13"N, 34°53'7.61"E

0 1 2 4 6 8 Kilometers

1:125,000

# WINNER of the Best DESIS Image Award!

Matthias Wocher, LMU  
Munich, Germany

Intensive agriculture in  
Eastern Bavaria, Germany  
observed by DESIS on  
14.06.2021



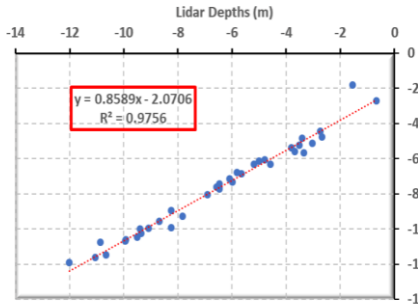
Combined information about vegetation plant traits derived from DESIS

# Can DESIS outperform Multispectral sensors for specific tasks?

Bathymetry: the submerged harbour of Amathus (I century BC), Cyprus

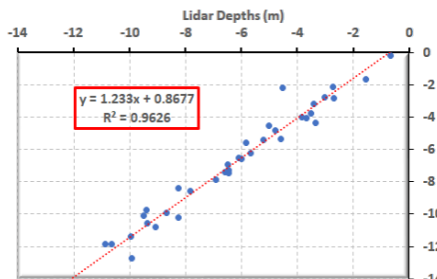


DESIS depth errors

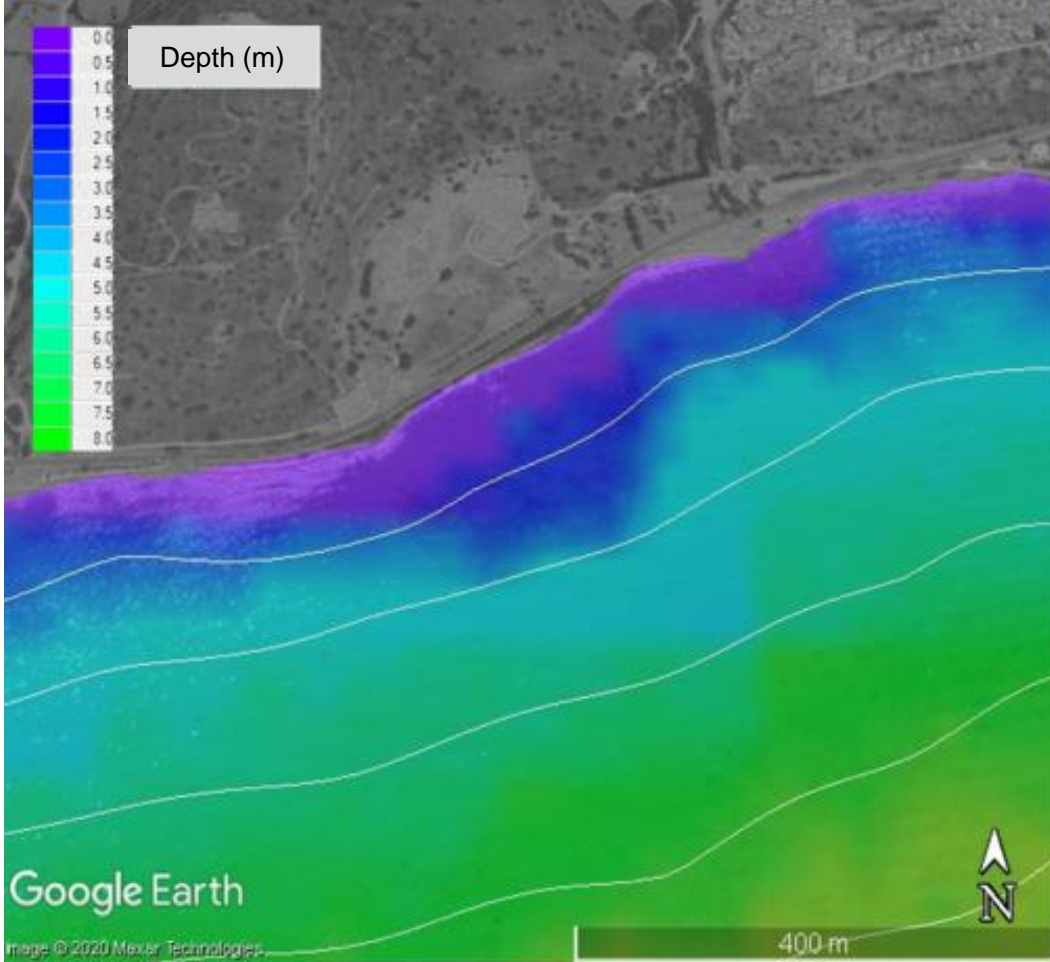


RMSE = 0.41 m

Sentinel-2 depth errors

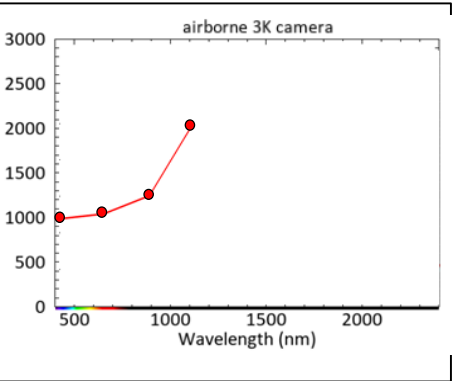
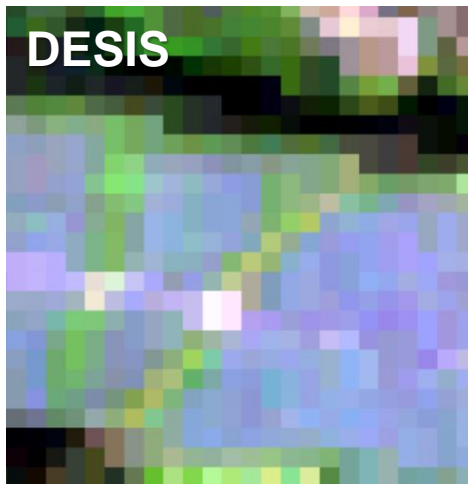
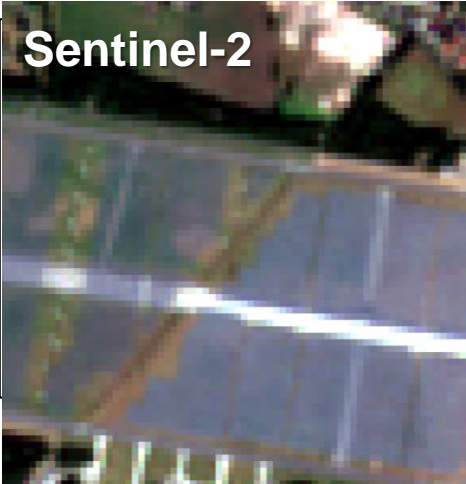


RMSE = 0.72 m

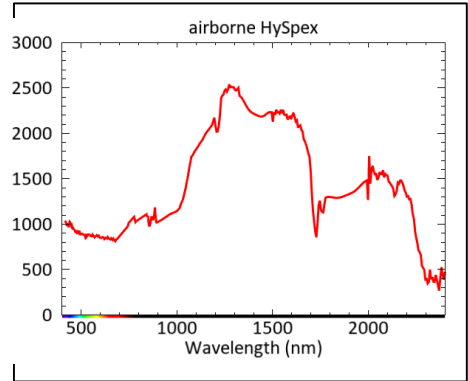


# Solar panels as seen by different optical sensors

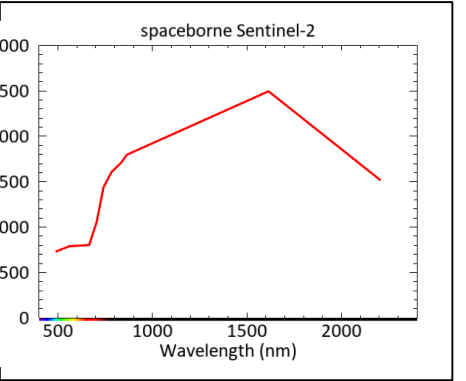
## Oldenburg, Germany, True color RGB composites



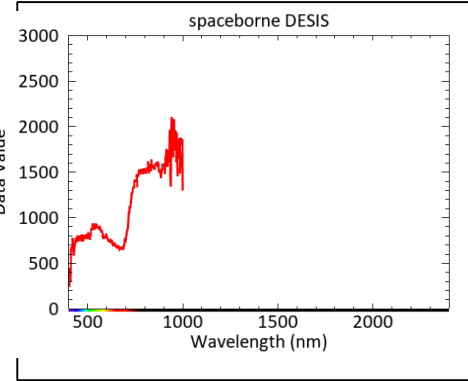
4 bands VNIR  
Airborne



Hyperspectral  
Airborne



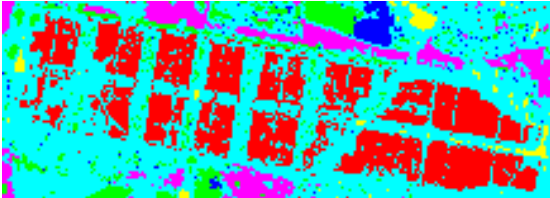
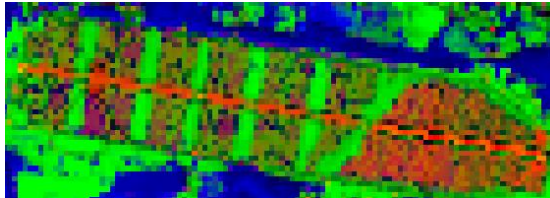
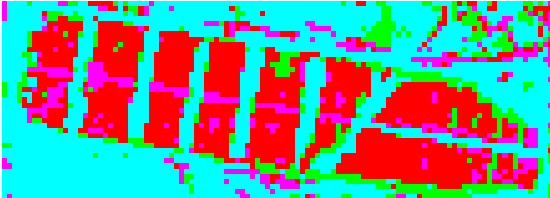
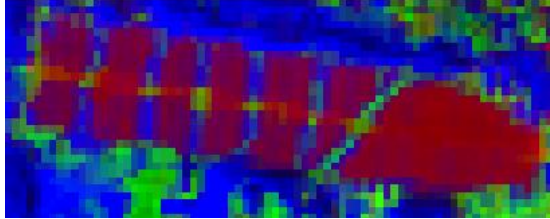
Multispectral  
Spaceborne



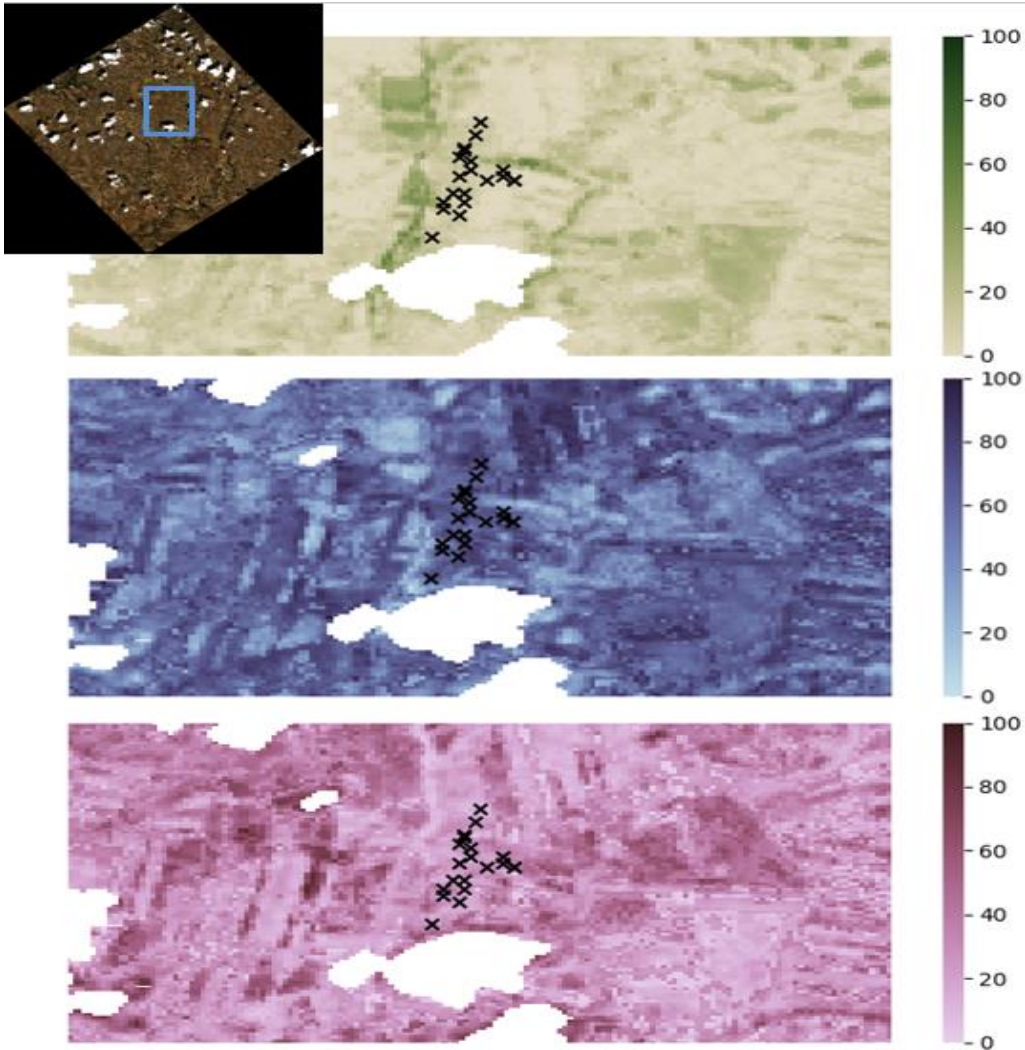
VNIR Hyperspectral  
Spaceborne

# PV Panels Surface Estimation: DESIS vs. Sentinel-2

Surface = number of PV pixels (red) x pixel size, or sum of fractional abundances (red)

Sensor		Estimation (ha)	PV area (ha)
Sentinel-2, classification		45.50	22.64
Sentinel-2, spectral unmixing		15.06	
DESI, classification		55.80	
DESI, spectral unmixing		22.63	

# Fractional vegetation cover for environmental modeling



Application of fractional vegetation cover retrieval for a DESIS observation of Camarena, Spain, 2020 (top-left)

Abundances in descending order for: PV, NPV and BS (%)

Location of field measurements are shown with black marks

RMSE:

EnMAP (with SWIR): 8%

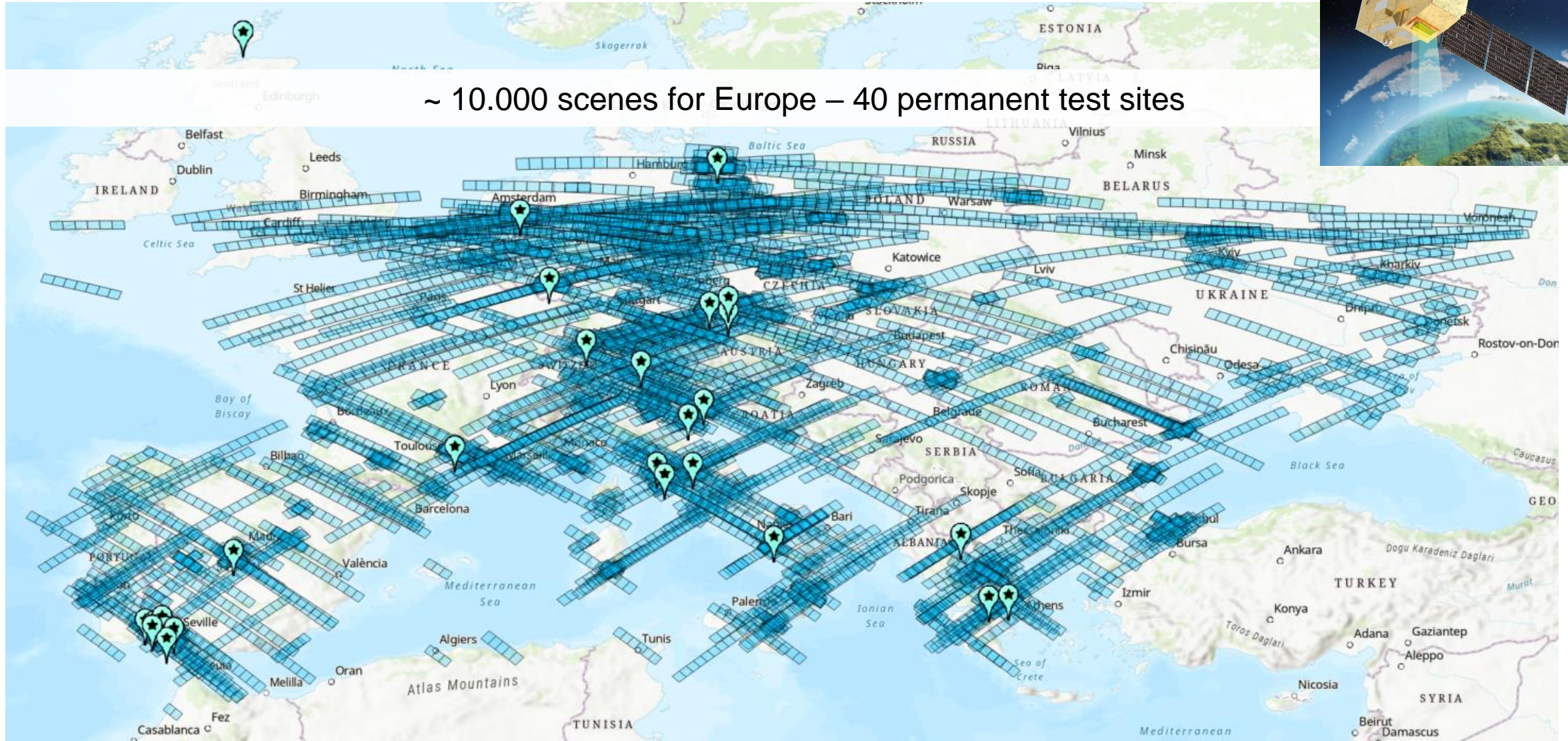
DESI (no SWIR): 14%

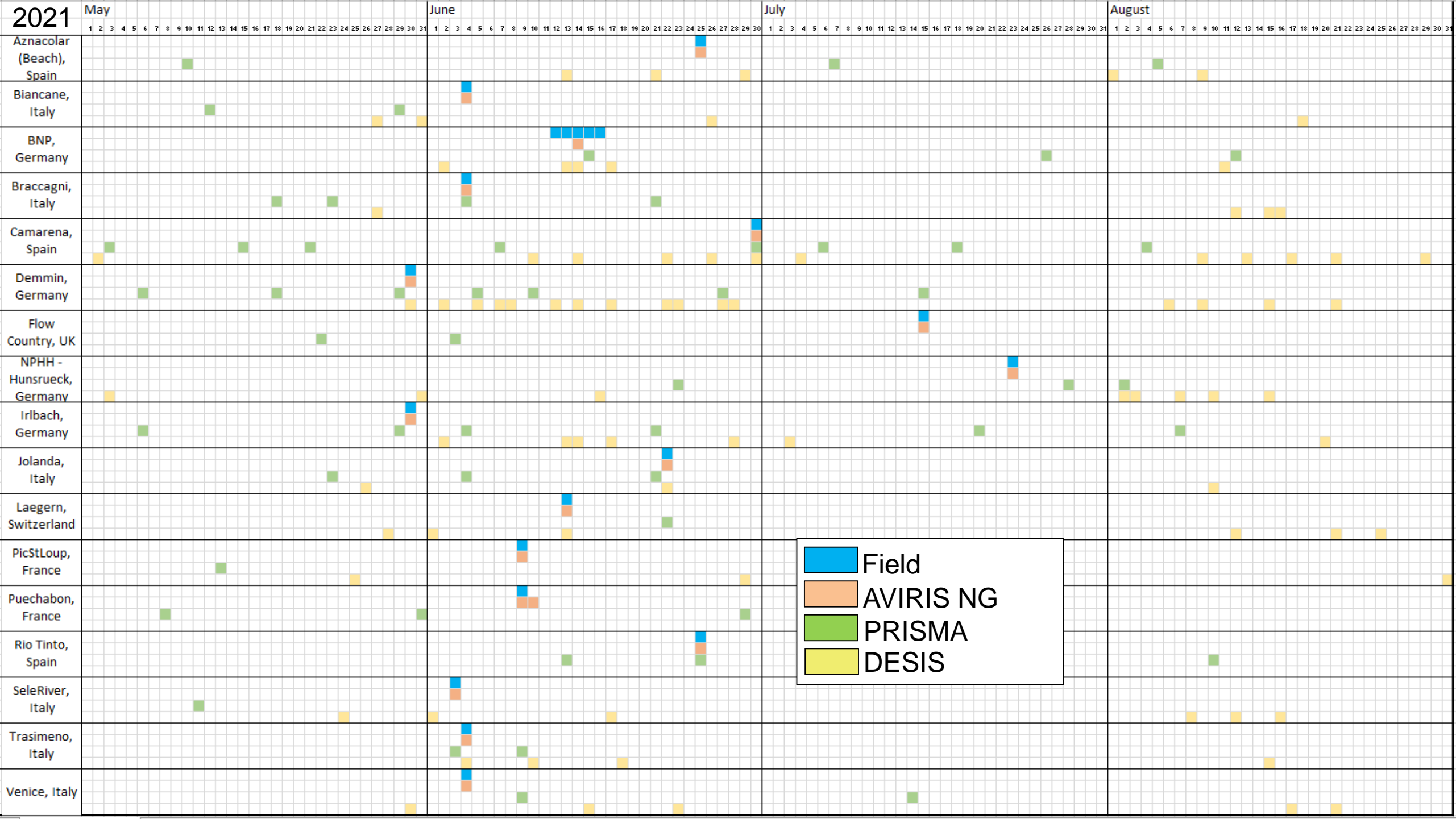


# CHIME preparatory activities

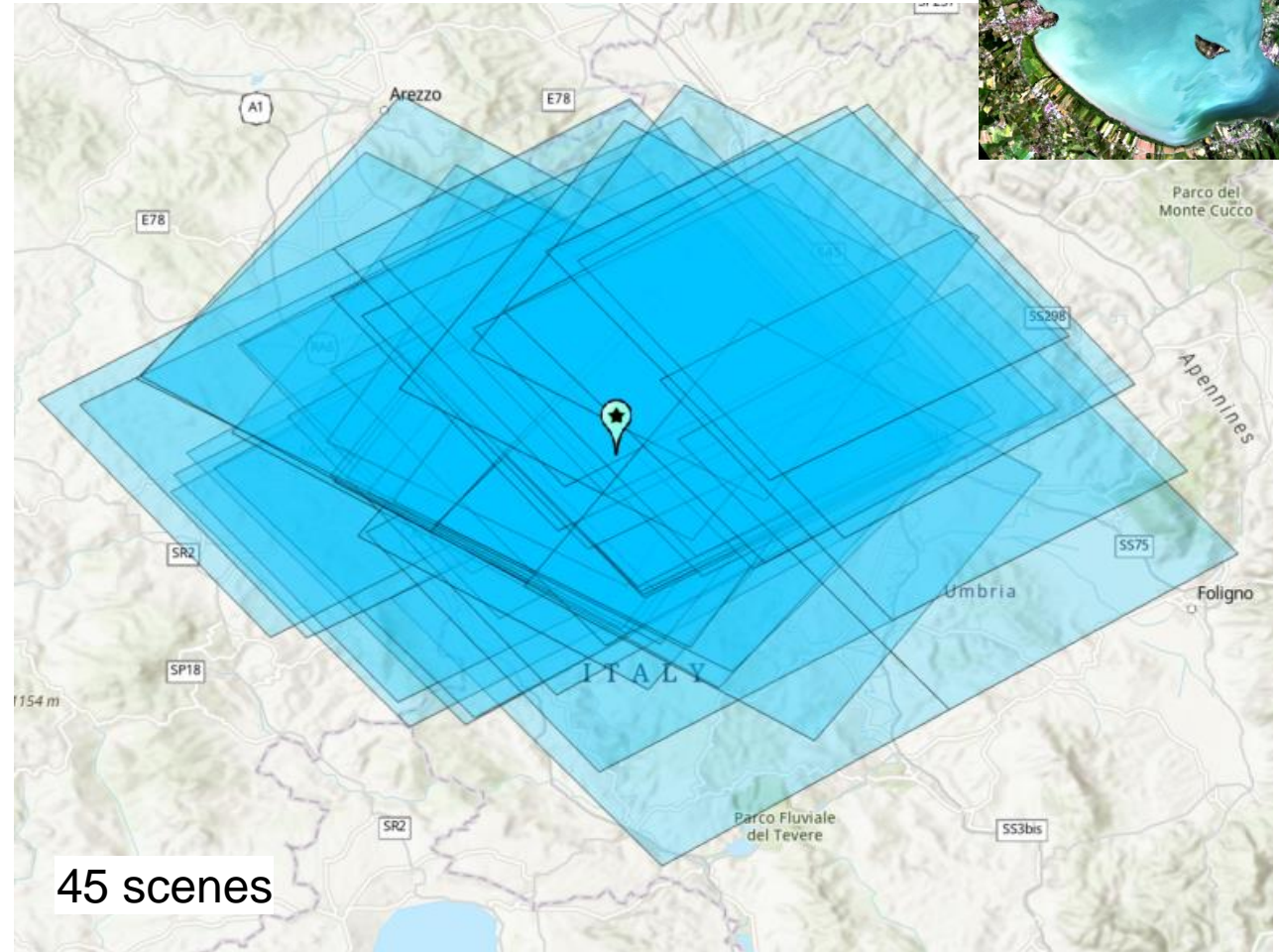
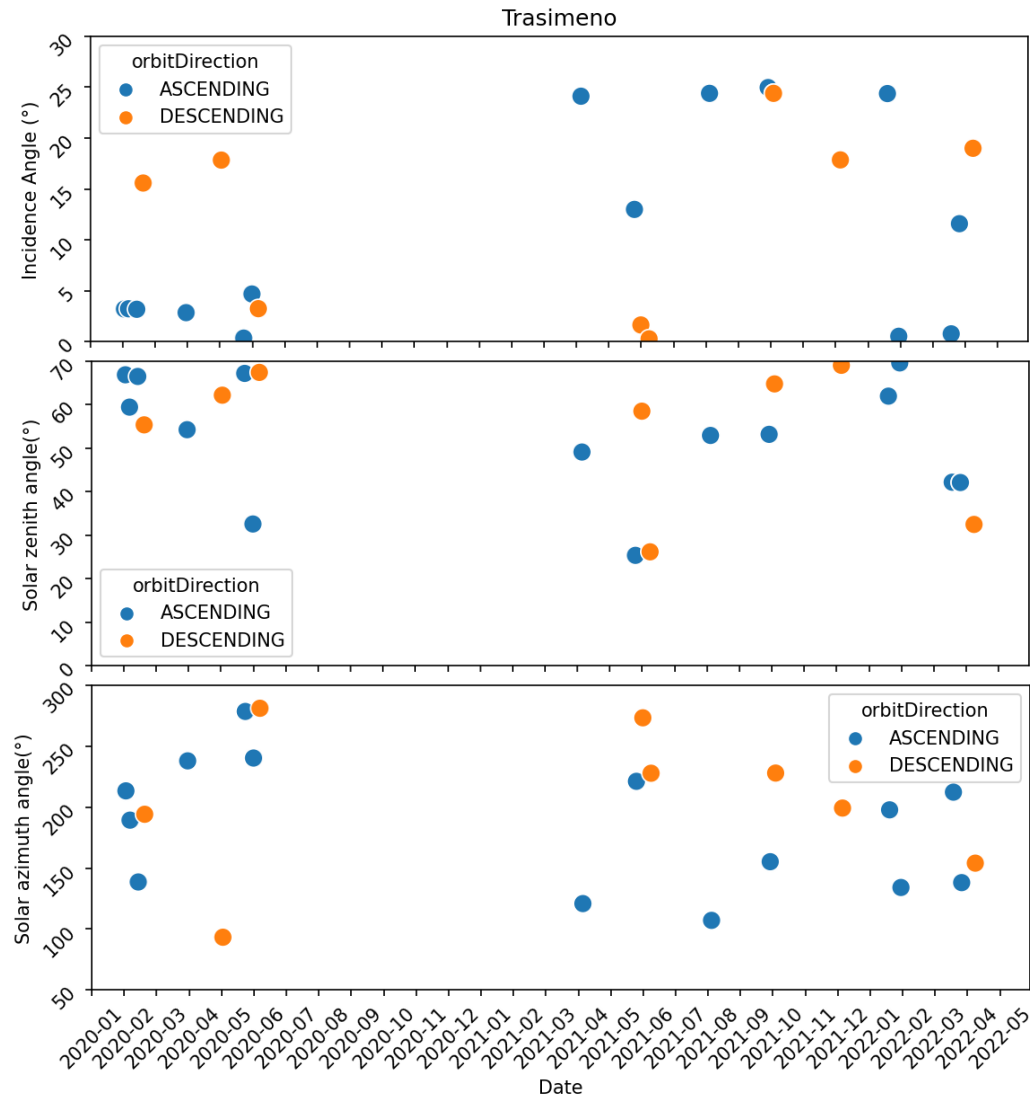


~ 10.000 scenes for Europe – 40 permanent test sites





# DEGIS acquisition variabilities – Aquatic sites: Lake Trasimeno, Italy



Thank you



DESI Launch

<https://www.dlr.de/eoc/desktopdefault.aspx/tabid-13614/>