DESIS Mission: Past, Current and Future Operations

2nd Workshop on International Cooperation in Spaceborne Imaging Spectroscopy
Frascati 19th – 21st October

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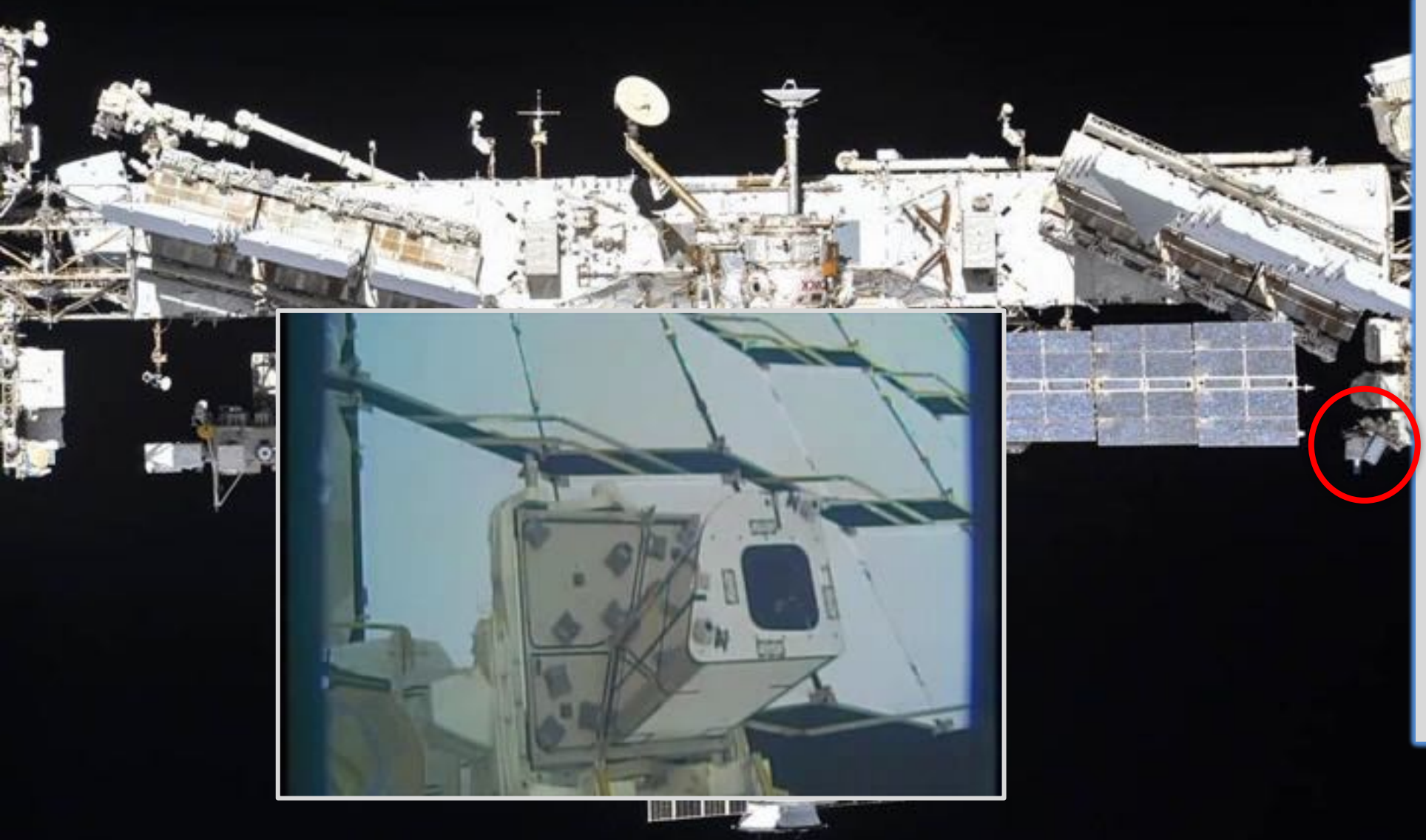
DESIS – Introduction / Platform



Teledyne Brown Engineering (USA) and **DLR** have partnered to build and operate the DLR Earth Sensing Imaging Spectrometer (**DESIS**) from the Teledyne-owned Multi-User System for Earth Sensing (**MUSES**) Platform on the ISS

DESIS, the hyperspectral sensor has been developed by DLR, which is currently the first payload of MUSES.

DLR also established the Ground Segment and licensed the SW processors to Teledyne running in an Amazon Cloud

DESIS – Introduction / Timeline

2014 / 2015

MUSES / DESIS Start Mission

7. June 2017

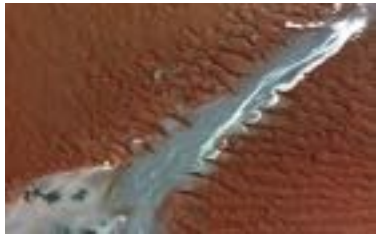
MUSES installation on ISS

29. June 2018

DESIS launch from Cape Canaveral to ISS via SpaceX Dragon

27.-28.08 2018

Installation of DESIS in MUSES. Start Commissioning Phase



23. October 2019

@ IAC Washington Start operational Phase (official announcement)

29.09.–01.10.2021

1st DESIS User Workshop (online)

Design, Implementation, Test | Commissioning | Operations

Mission Instrument	ISS/MUSES DESIS
Off-nadir tilting (across-track, along-track)	-45° (backboard) to +5° (starboard), -40° to +40° (by MUSES and DESIS)
Spectral range	400 nm to 1000 nm
Spectral (res., acc.)	2.55 nm, (*)
Radiometry (res., acc.)	13 bits, (*)
Spatial (res., swath)	30 m, 30 km (@ 400 km)

Mission Instrument	ISS/MUSES DESIS
Target lifetime	2018-2023
Satellite (mass, dimension, usage)	455 t, 109.0×97.9×27.5 m^3 (multi-purpose)
Orbit (type, local time at equator, inclination, height, repeat cycle)	not Sun-synchronous, various, 51.6°, 320 km to 430 km, no repeat cycle
Coverage	55° N to 52° S
Revisit frequency	3 to 5 days (average)

DLR

DESIS – Mission Objectives

(1) Increase multitemporal data acquisitions for sites, including different observation and illumination geometries

(2) Support the running EnMAP mission as well as the upcoming CHIME mission

(3) Increase multisensorial data exploitation by cooperating with other running hyperspectral missions such as PRISMA, EMIT and EnMAP in terms of joint calibration, validation and data harmonisation activities

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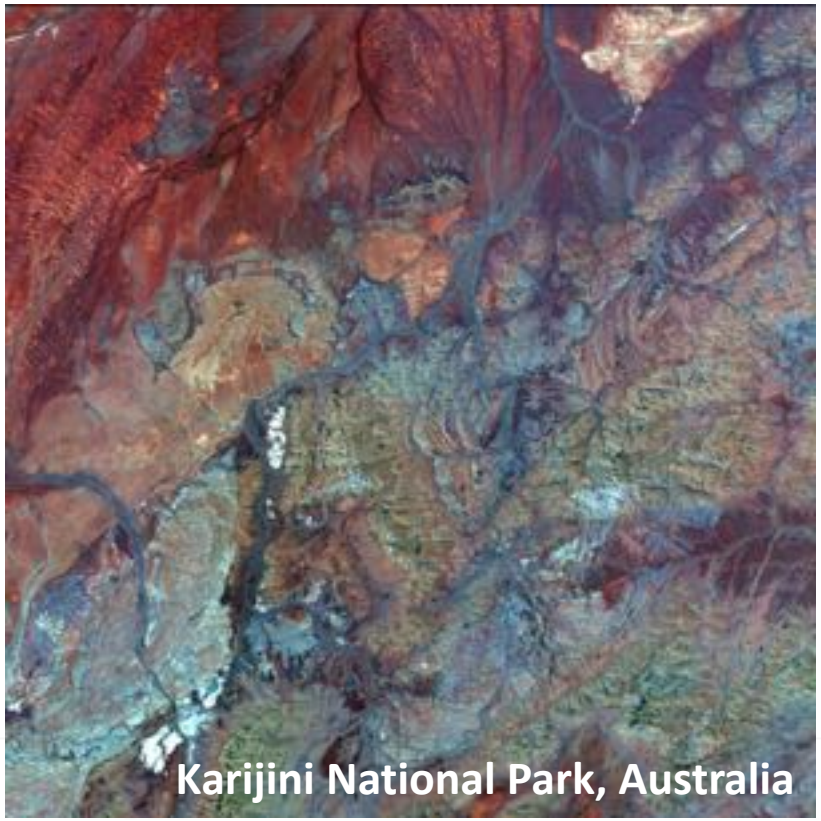

Karijini National Park, Australia


Dead Sea, Israel / Jordan


Baltic Sea, Germany

DESIS – Acquisition Capacity

Status September 2022:

- ~ 167.000 scenes processed (archive)
- < 100% of the land surface of the Earth
- ~ 82 TB data in the archive
- ~ 12.300 scenes for Europe
- Note: DESIS is not a mapping mission
- Priority to multitemporal acquisitions
- DESIS supports e.g. preparatory activities of CHIME (2020, 2021, 2022, 2023 …)

DLR


CHIME Sites
Number of scenes
1 - 4
4 - 6
6 - 8
8 - 10
10 - 13
13 - 15
15 - 18
18 - 21
21 - 24
24 - 29
29 - 35
35 - 63
IRELAND
NETHERLANDS
GERMANY
BELGIUM
LUXEMBOURG
FRANCE
SWITZERLAND
AUSTRIA
CZECHIA
SLOVAKIA
POLAND
BELARUS
UKRAINE
HUNGARY
SLOVENIA
CROATIA
ROMANIA
MOLDOVA
BOSNIA AND HERZEGOVINA
SERBIA
MONTENEGRO
BULGARIA
NORTH MACEDONIA
ALBANIA
GREECE
ITALY
SPAIN
PORTUGAL

DESIS – Data products

Archive

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

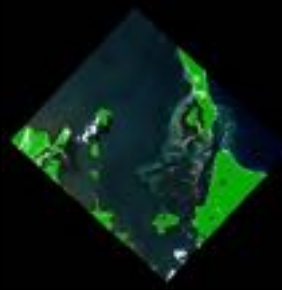
Analysis Ready Data

L1B Top-Of-Atmosphere (TOA) Radiance

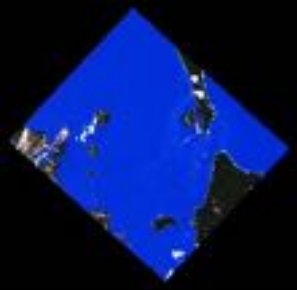
L1C Geocoded & Orthorectified

L2A Bottom-of-Atmosphere (BOA) Reflectance

Land Mask



Water Mask



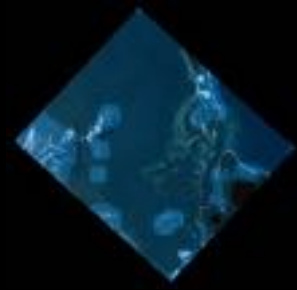
Cloud Mask

Cloud Shadow over land

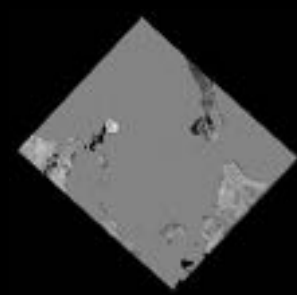
Haze over land

Haze over water

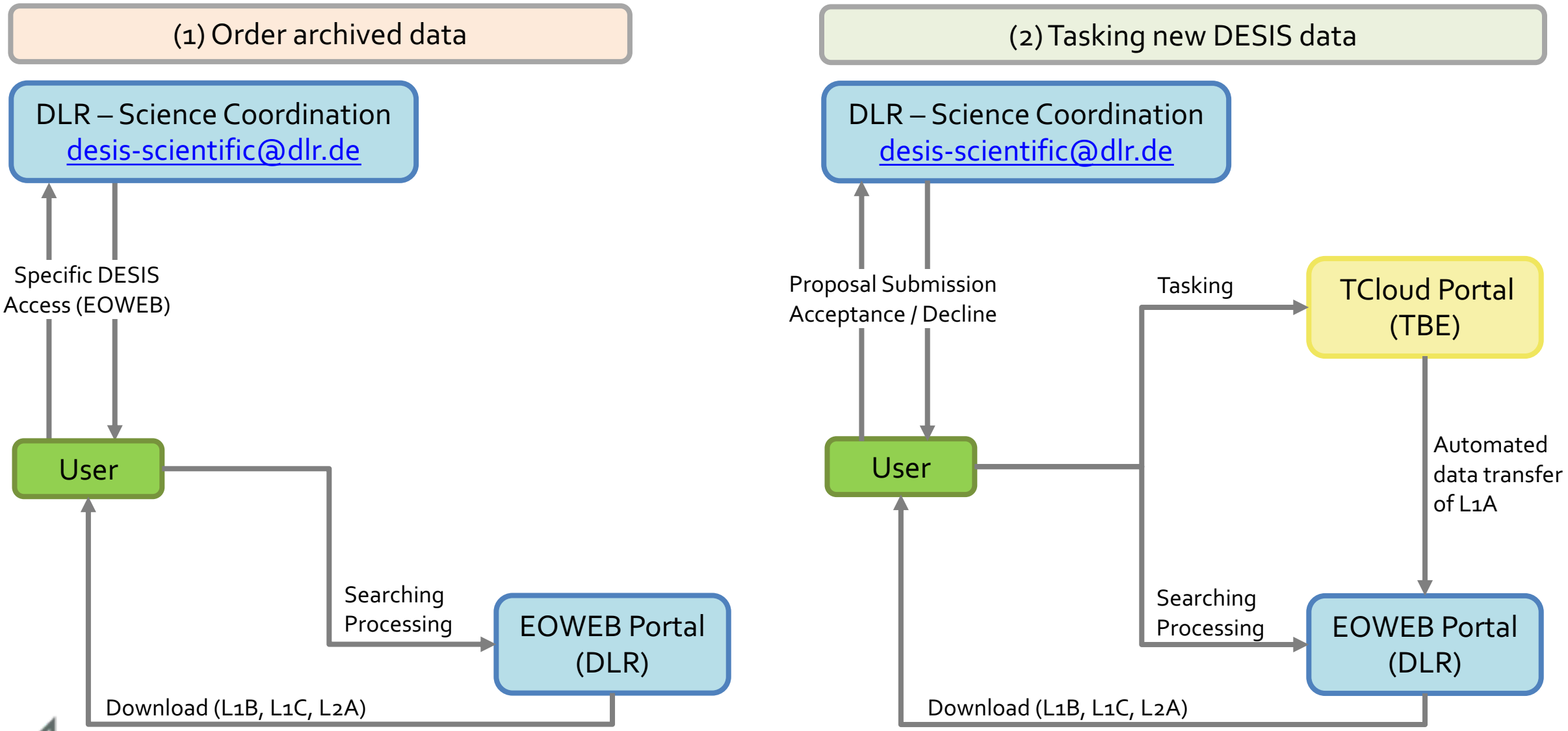
AOT Map



WV Map



DESIS – Data policy and access



DESIS – Web Information

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

- Web-Information about Calibration and Processor changes:
  - Updates of the calibration data and
  - Improvements and changes of the DESIS data processors

Date	Software	Remarks
14-Jan-2022	V02.14	L1A / L1C Processor Component – Leap Seconds Fix • This fix handles the UTC to GPS time as well as GPS to UTC time calculations
1-Jun-2021	V02.13	L2A Processor Component – Bug Fix • This bug fix in the algorithm improves the scene AOT (visibility) estimation using dark pixels (Red/NIR wavelengths) affecting mainly water-land scenes (very seldom cases).
11-May-2021	V02.12	Calibration Updated to version V02.06. This SW release contains the following changes (please note that release V02.11 has been never installed at TBE and therefore the changes below are with respect to V02.10) L1B Processor Component • Updated of the algorithm to apply the striping correction table to separate the case low temperature gradient from high temperature gradient L2A Processor Component • Improvement in the AOT retrieval over water with a smoother transition between land and water • Change BOA reflectance from unsigned to signed integer to allow negative reflectance • Set haze sigma threshold and moved haze detection band to around 420 nm avoiding around 430 nm wavelengths. • Avoid DEM information in the atmospheric correction on cloud pixels • Avoid over correction over water inside the water vapor absorption bands • Fixed return value for high zenith angle scenes • Correct AOT map scaling factor • Adapt scale path radiance for scenes without DDV pixels • Changed DEM creation routines for large stdout messages • Solved wrong error code for high zenith angles • Improved system calls to avoid problems when stdout is too large • Increase clouds threshold from 20% to 30% due to the changes in the calibration tables. Clibration Tables

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- Events:
  - 1st DESIS User Workshop, 28th Sept to 1st Oct, 2021
  - Planning for the 2nd DESIS User Workshop 2023 started!

Tuesday, 28.09.2021

Introduction + Keynotes

- Introductory session: Welcome, Workshop objectives, Agenda, DESIS Best Image Award
  Rupert Müller, DLR
- Greeting and Welcome to the workshop (Video 23.1 MB)
  Anke Kaysser-Pyzalla, DLR
- Introduction to the history and current activities of the mission from the scientific perspective
  Uwe Knodt, DLR
- DESIS - from adventure to business
  Hansjörg Dittus, DLR
- Commercial perspective and use of DESIS data
  Jack Ickes, TBE
- DESIS Best Image Award
  Uta Heiden, DLR

DESIS Mission

- The design of the DESIS instrument
  David Krutz, DLR
- L1B and L1C processing and DESIS calibration
  Kevin Alonso, DLR
- The DESIS L2A processor and validation of L2A products using AERONET and RadCalNet data (Abstract)
  Raquel de los Reyes, DLR
- The spectral and radiometric quality of the DESIS data products, and the influences on higher-level processing
  Martin Bachmann, DLR
- TCloud Use for DESIS Data and Best Practices
  Heath Lester, TBE
- Proposal process and EOWEB functionalities
  Uta Heiden, DLR

Spectral Unmixing / Target Detection

- An automated operational processor for the determination of fractional vegetation cover from DESIS observations
  David Marshall, DLR

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- DESIS Product Reader
  - EnMAP-Box
  - Open-source Python plug-in for QGIS

- Preparing DESIS for CEOS Analysis Ready Data for Land – CARD4L

DESIS – Public Documentation for Scientific and Commercial U

Thank you for your attention!

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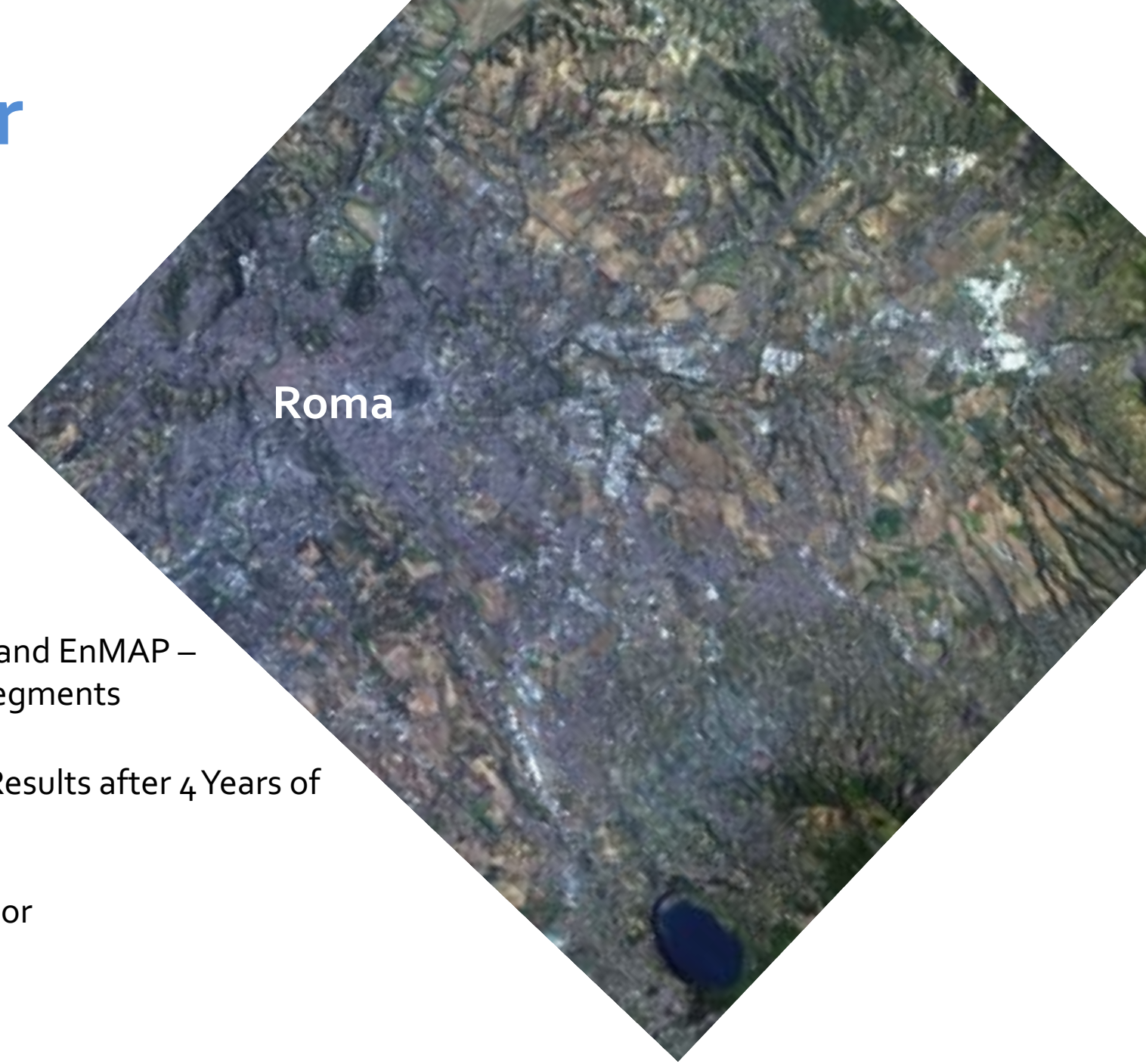
DESIS Science Coordinator

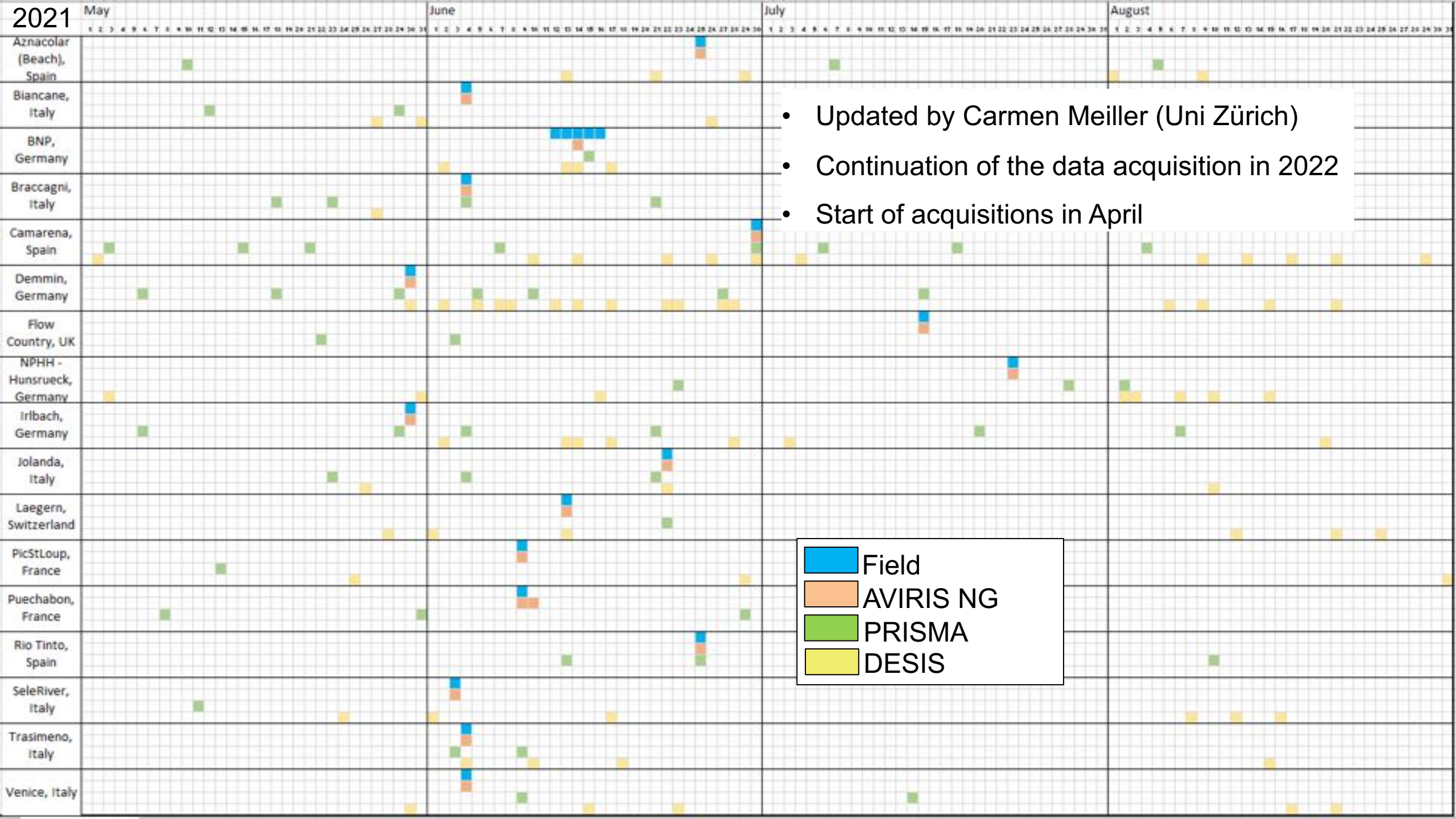


Bachmann et al.: Ready Data (ARD) for DESIS and EnMAP – Ensuring the Data Quality within the Ground Segments

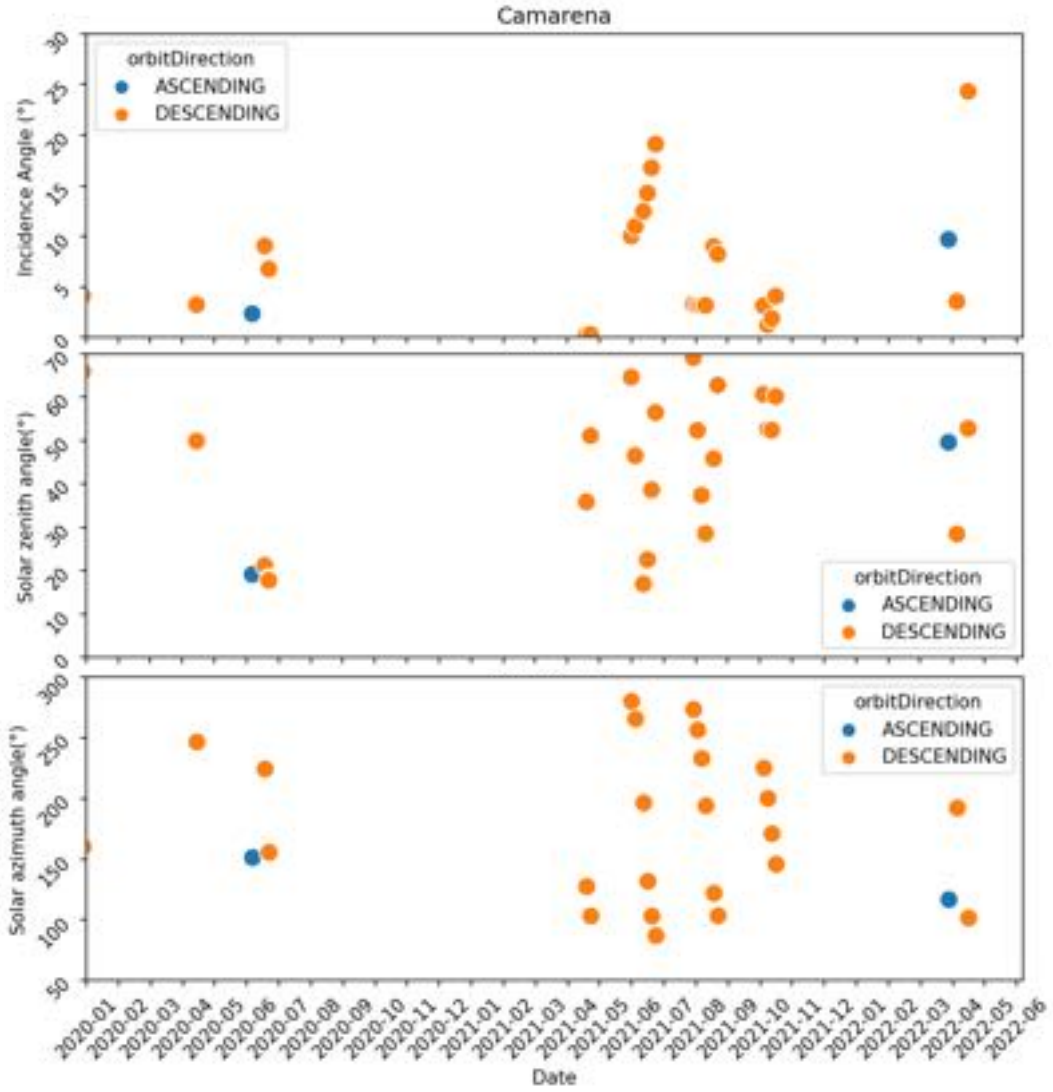
Carmona et al.: DESIS Calibration: Status and Results after 4 Years of Operation

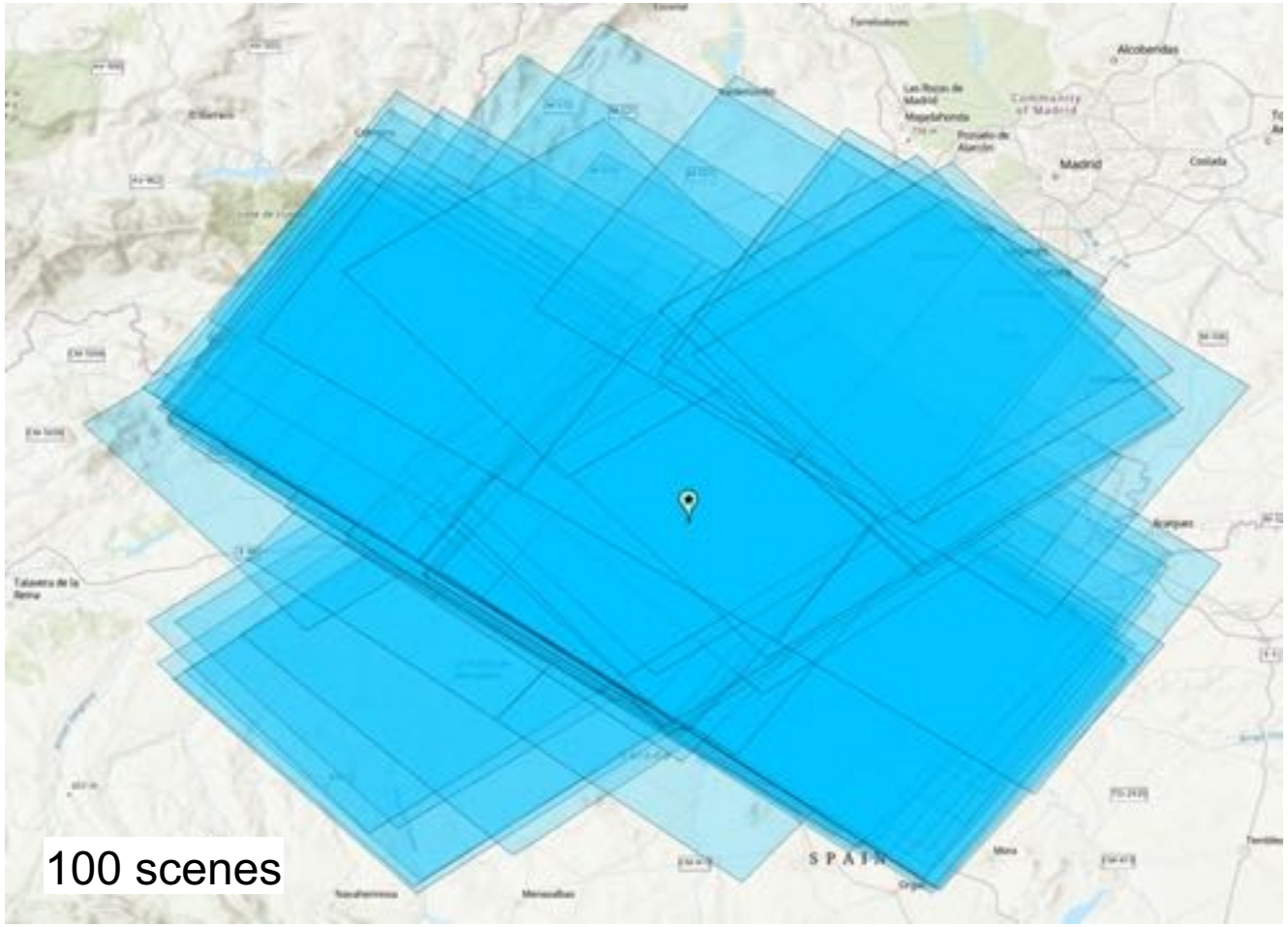
de los Reyes et al.: DESIS / EnMAP L2A processor

DLR


2021
May
June
July
August
Aznacolar (Beach), Spain
Biancane, Italy
BNP, Germany
Braccagni, Italy
Camarena, Spain
Demmin, Germany
Flow Country, UK
NPHH - Hunsrueck, Germany
Irlbach, Germany
Jolanda, Italy
Laegern, Switzerland
PicStLoup, France
Puechabon, France
Rio Tinto, Spain
SeleRiver, Italy
Trasimeno, Italy
Venice, Italy
• Updated by Carmen Meiller (Uni Zürich)
• Continuation of the data acquisition in 2022
• Start of acquisitions in April
Field
AVIRIS NG
PRISMA
DESIS

DESIS acquisition variabilities - Agricultural sites: Camarena, Spain

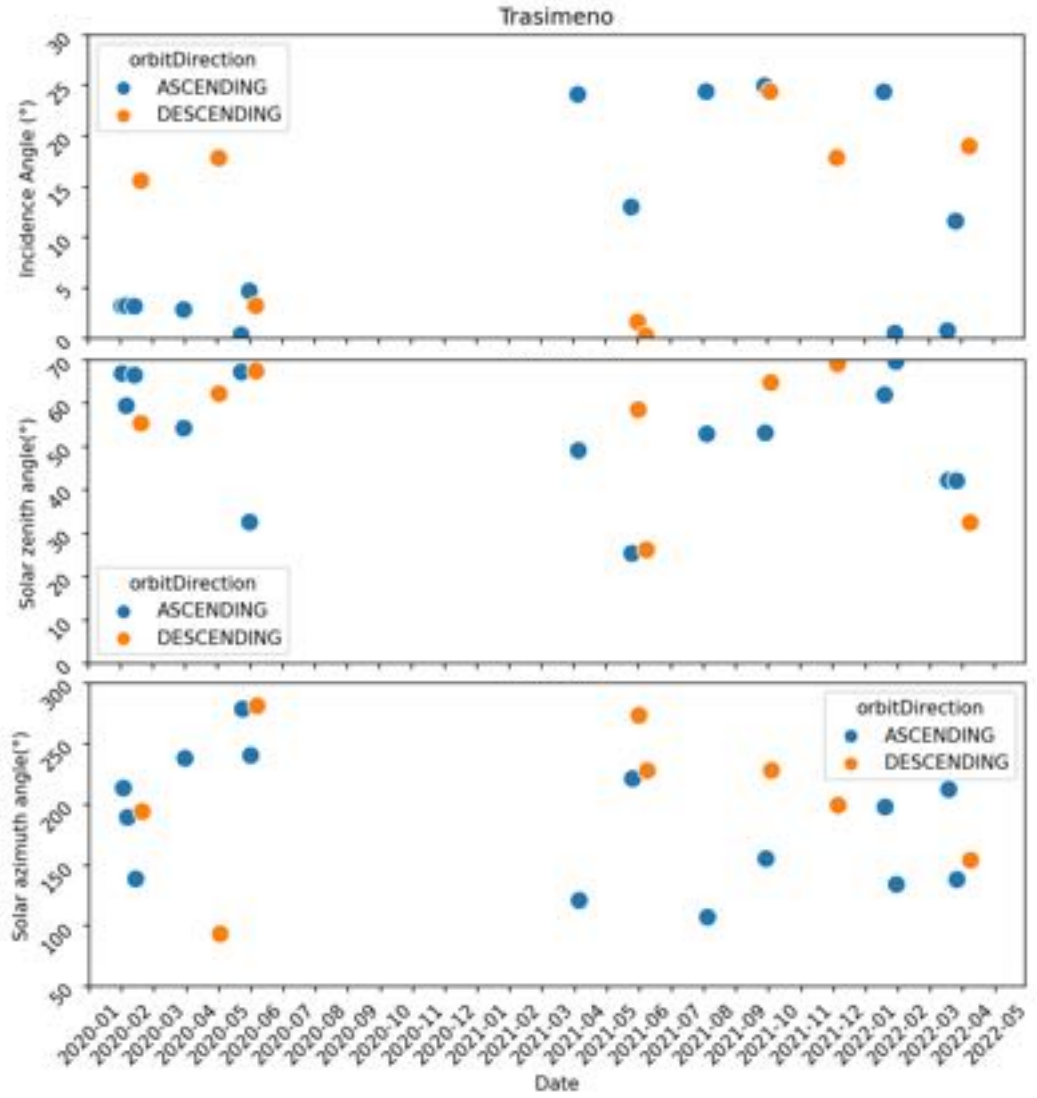


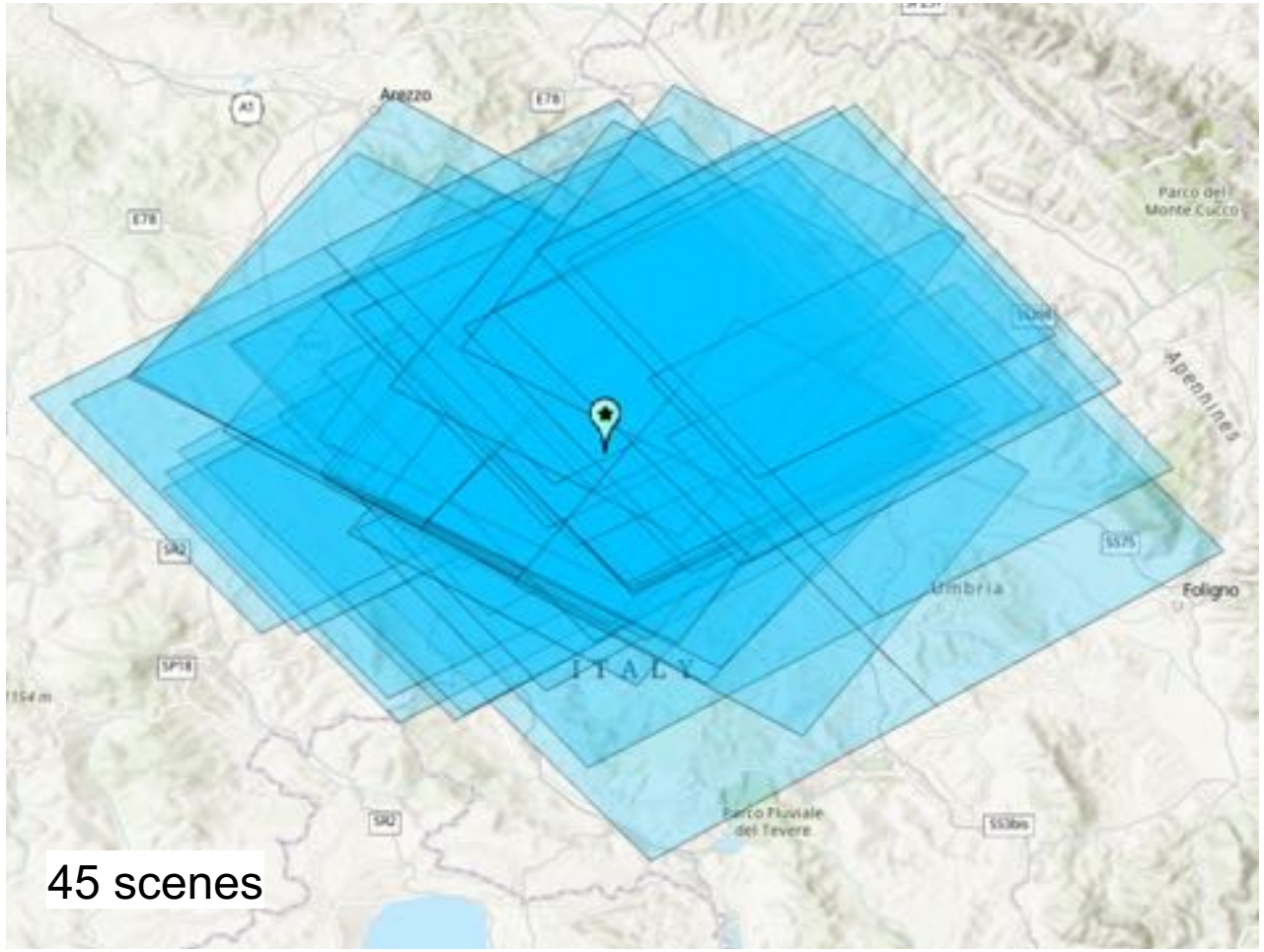


* Standing acquisition request of 40 CHIME sites across Europe

DLR

DESIS acquisition variabilities – Aquatic sites: Lake Trasimeno, Italy





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