DESIS MISSION AND DATA ACQUISITION STATUS

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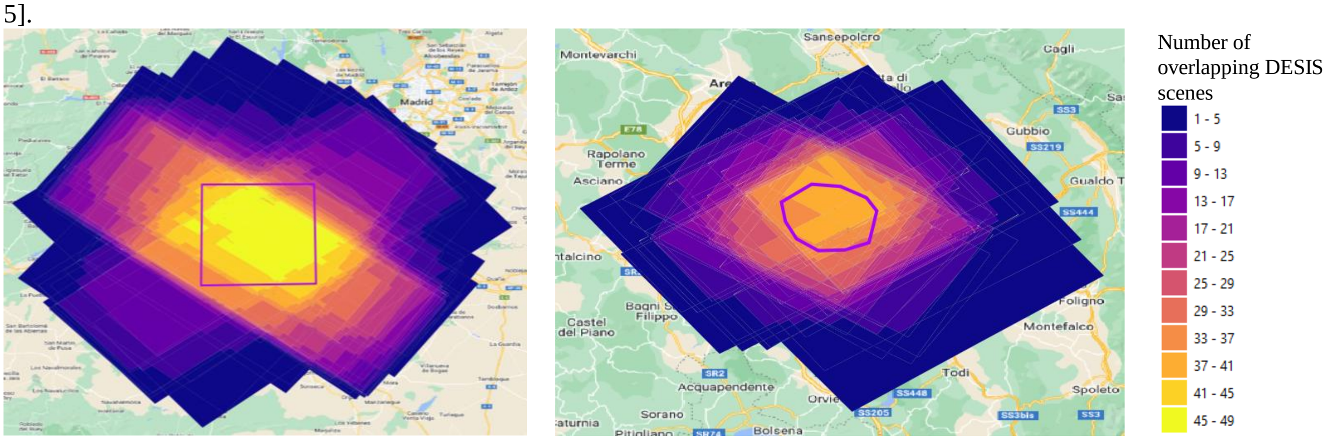
The DLR Earth Sensing Imaging Spectrometer (DESIS) has been in operation for four years. This report provides information about the past, current, and future operations of DESIS. In 2014, Teledyne Brown Engineering (TBE, USA) and the German Aerospace Center (DLR, Germany) collaborated to build and operate the DESIS instrument. DESIS is plugged into the Multi-User System for Earth Sensing (MUSES) platform [1] on the International Space Station (ISS) [2, 3], with TBE providing the infrastructure for operations and data tasking. DLR developed and built the instrument and software for data processing and delivery and is responsible for the scientific exploitation of the mission.

DESIS is equipped with an onboard calibration unit and a rotating pointing mirror (POI), which can also change the line of sight in the forward/backward direction [3]. This makes DESIS very flexible for data tasking, especially for the tasking of areas at higher latitudes which compensates for the limitations of the ISS orbit that reaches a 52° maximum latitude. Further, it allows the observation of the same area with different pointing angles within an overflight. Approximately four years after the start of the mission's planning, the DESIS spectrometer was integrated into MUSES in August 2018, marking the beginning of the commissioning phase. The data processing chain, installed at DLR for scientific users and at Amazon Web Service for commercial users, then started to generate operational data products available for users (L1B, L1C and L2A) [4, 5].



A) Agricultural area around Camarena, Spain B) Area covering Lake Trasimeno, Italy

Figure 1: Heatmap showing the number of overlapping DESIS scenes taken from 2019 – 2022.

Since 2019, DESIS has acquired data worldwide for scientific and commercial users, which is available for scientific purposes based on a free and open data policy. The data can be accessed using the archive of the EOWEB portal of DLR and the TCloud archive of TBE. For the remaining operation time, the DESIS mission will focus on the following objectives: (1) increasing multitemporal data acquisitions for sites including different observation and illumination geometries, (2) supporting the running EnMAP mission as well as the upcoming CHIME mission, and (3) increasing multisensorial data exploitation by cooperating with other running hyperspectral missions such as PRISMA, EMIT, HISUI and EnMAP in terms of joint calibration, validation and data harmonization activities [6]. This report provides an overview of the DESIS mission, data quality and data access and offers examples and perspectives on the scientific exploitation of the mission [e.g. 7]. Additionally, it will showcase the contribution of DESIS to the CHIME mission, specifically for the CHIME test sites that have been constantly observed by DESIS since 2019. In Figure 1, two examples of CHIME sites are given. The core area of Camarena (Figure 1A) is covered by 45 to 49 DESIS acquisitions that are taken between 2019, the first year of the CHIME data acquisitions and the end of 2022. For Lake Trasimeno in Italy (Figure 1B), there are 39 overlapping DESIS scenes. This enables the development of algorithms for ecosystem processes [8] and thus, the monitoring of seasonal as well as multi-year variabilities. Figure 2 shows all data acquisitions available in the DESIS archive between September 2018 and June 2022 and the overlap with all CHIME sites that DESIS is able to task.

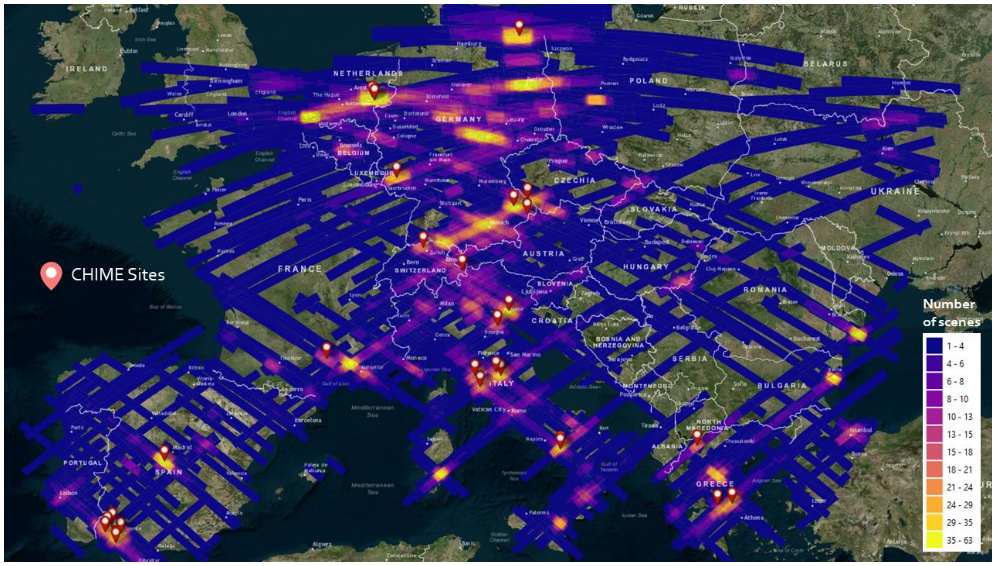


Figure 2: DESIS data acquisition heatmap for Europe showing all available DESIS scenes in the archive (September 2018 and June 2022).

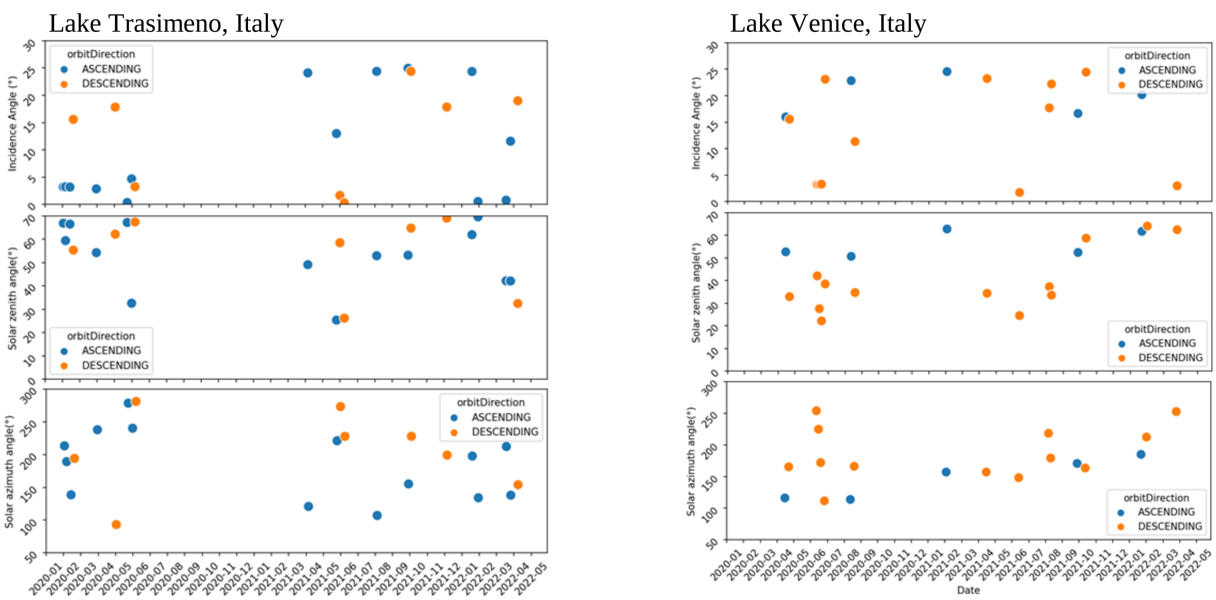


Figure 3: The points mark DESIS data acquisitions in relation to sensor incident angle, solar zenith and solar azimuth angle for two test sites.

DESIS data acquisition opportunities are based on the non-sun-synchronous ISS orbit, resulting in observation and illumination conditions that are difficult to reproduce. However, DESIS time series contains images of different day times, sensor incident angles, and solar zenith angles (Figure 3), which can open new opportunities for monitoring Earth system processes that have daily variability, such as photosynthesis. Furthermore, DESIS multitemporal data stacks can be an essential database for algorithm and operational processor developments that need to handle massive data volumes. The DESIS data archive is open for such research and developments, making it a valuable imaging spectroscopy data source.

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