Universität Zürich[UZH]

Department of Geography

ARES
AIRBORNE RESEARCH OF THE EARTH SYSTEM

The ARES Multi-Sensor Airborne Observatory

The ARES Observatory is a Swiss state-of-the-art airborne remote sensing platform. It features an imaging spectrometer, a full-waveform LiDAR, and a photogrammetric camera. ARES acquires unique multi-sensor datasets for various applications, such as vegetation monitoring and urban studies.

Marius Vögtli[1], Jesse Ray Murray LaHaye[2], Jan Skaloud[2], Andreas Hueni[1]

[1] Department of Geography, University of Zurich
[2] ESO Lab, École polytechnique fédérale de Lausanne

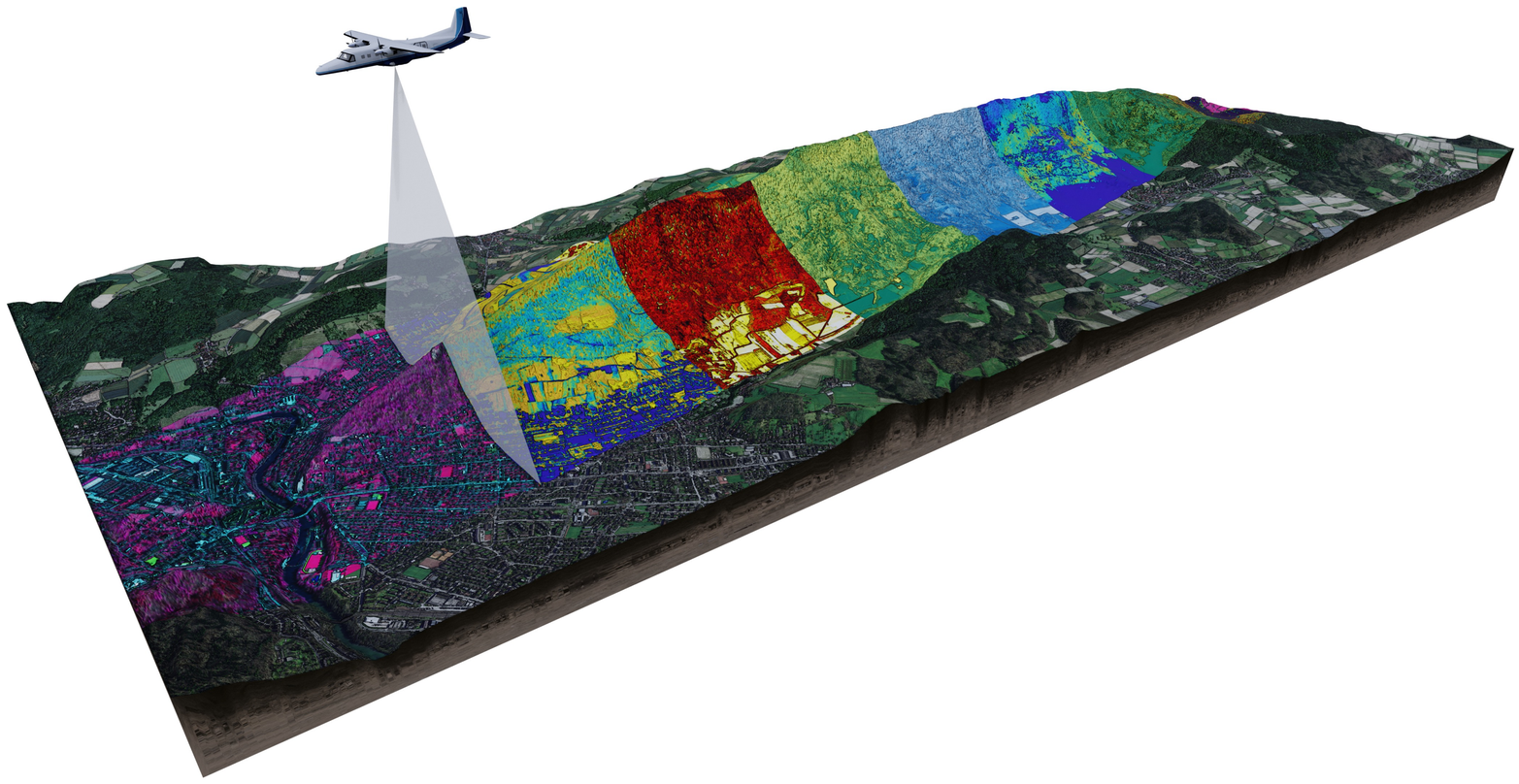


Fig. 1: Exemplary products derived from ARES hyperspectral and LiDAR data. AVIRIS-4 products include FCI (Forest Cover Index), NDVI (Normalized Difference Vegetation Index), CCI (Chlorophyll/Carotenoid Index), CIre (Red-Edge Chlorophyll Index) and NDWI (Normalized Difference Water Index). LiDAR-derived products include Canopy Height, Plant Area Index (PAI) and Foliage Height Diversity (FHD). Source: F. Morsdorf (UZH).

ARES Instruments

AVIRIS-4

The Airborne Visible/Infrared Imaging Spectrometer-4 (AVIRIS-4) is a state-of-the-art **hyperspectral sensor** built by NASA JPL. It measures reflected light in the visible to shortwave infrared range (375 nm to 2500 nm) in 287 contiguous bands. Between the lowest and highest flight altitude, image data with a ground resolution of 0.3 m to 3.5 m per pixel can be acquired.

Riegl VQ-1560 II-S

The Riegl VQ-1560 II-S is a **full-waveform airborne laser scanner** with two channels with a pulse repetition rate of up to 2 x 2000 kHz and a measurement rate of up to 2 x 1.33 MHz at a wavelength of 1064 nm. Depending on configured pulse repetition rate, flight speed, and flight altitude, 3D point clouds with a point density exceeding 40 points m^{-2} can be generated.

Phase One iXU-RS 1000

The Riegl VQ-1560 II-S houses a built-in Phase One iXU-RS 1000 **photogrammetric camera** with a 100 MP RGB sensor. From a flight altitude of 1000 m AGL, imagery with a spatial resolution of 4.6 cm can be captured and, together with the 3D point clouds from the airborne laser scanner, used to generate true orthophotos and colorized 3D point clouds.

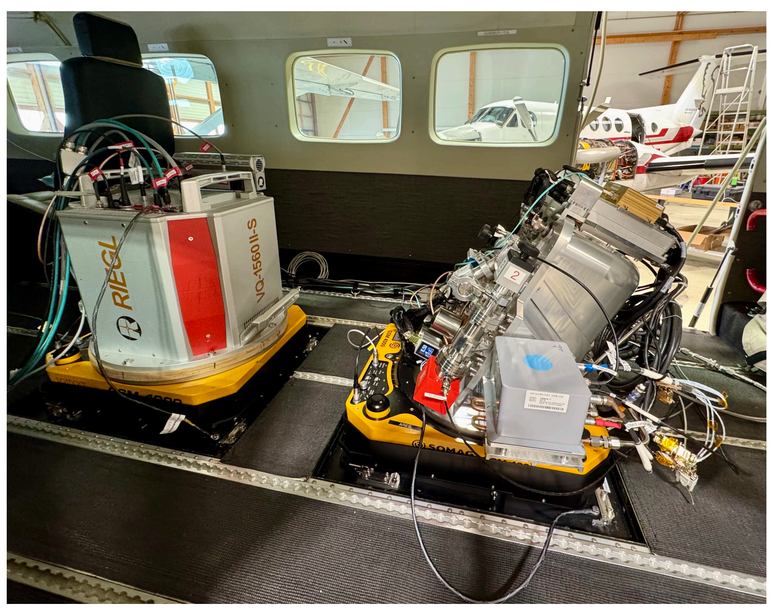


Fig. 2: The Riegl laser scanner (left) and the AVIRIS-4 imaging spectrometer (right) built into the aircraft. Source: M. Vögtli (UZH).

ARES Data

Multi-Sensor Data

ARES simultaneously acquires hyperspectral, LiDAR and RGB data with a common geometry and acquisition time. This enables **direct integration of structural, spectral and photogrammetric information** for environmental monitoring, natural hazard assessment and urban analyses. LiDAR captures 3D structure, while hyperspectral imagery characterizes surface composition and condition.

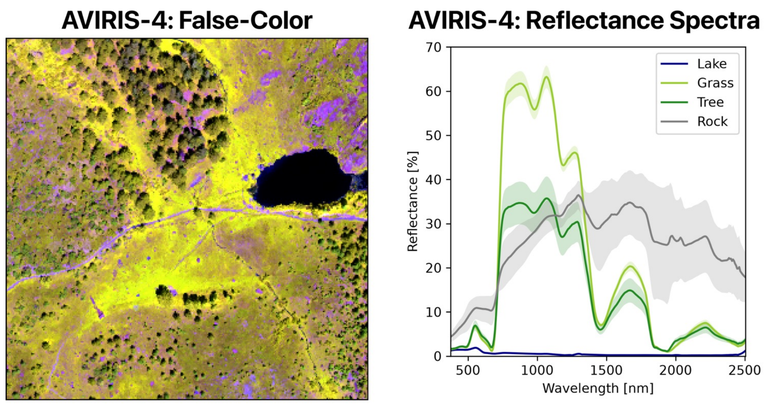


Fig. 3: Overview of different products generated from an ARES mission in Lötschental (Switzerland) on 11 June 2025. Source: M. Vögtli (UZH).

ARES Activities

Swiss and European Airborne Missions

Since its first flight in 2024, ARES has completed **111 airborne missions** in 13 European countries and acquired a total of **795 flight strips**. Among the top applications so far were vegetation studies, methane detection, and geological surveys. Some exemplary missions in Switzerland include:

- **Swiss National Park** in 2024 and 2026 for vegetation and ecosystem assessment
- **Blatten** landslide in 2025 and 2026 for debris fan characterization
- **Aletsch Glacier** in 2025 for glacier debris cover and albedo estimation
- **Hardwald** and various other forest sites in 2026 for drought impact studies

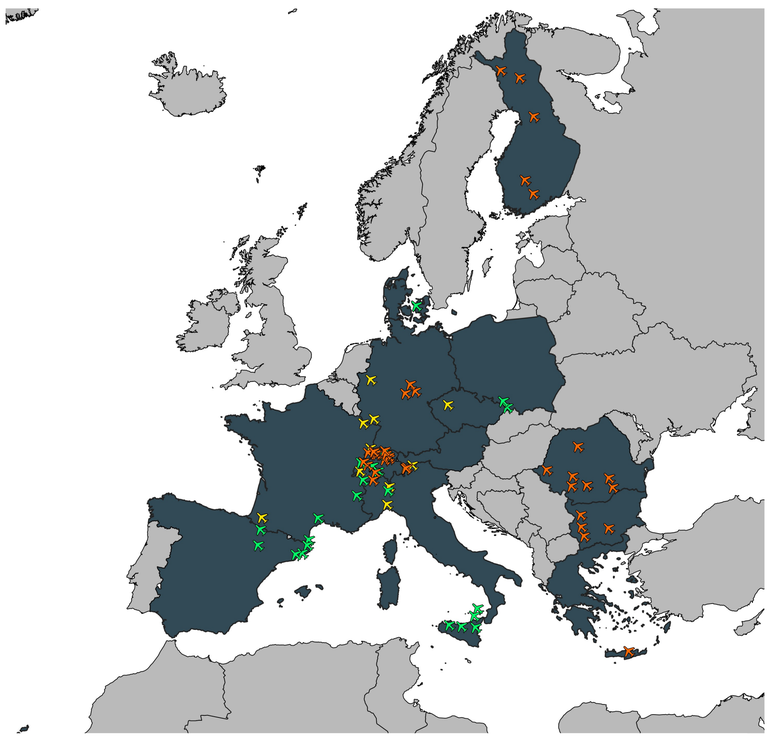


Fig. 4: Overview of ARES missions. Source: ARES with NaturalEarth map data.

ARES LinkedIn

Contact
Marius Vögtli
ARES Co-Lead
AVIRIS-4 Data Scientist
marius.voegtli@geo.uzh.ch