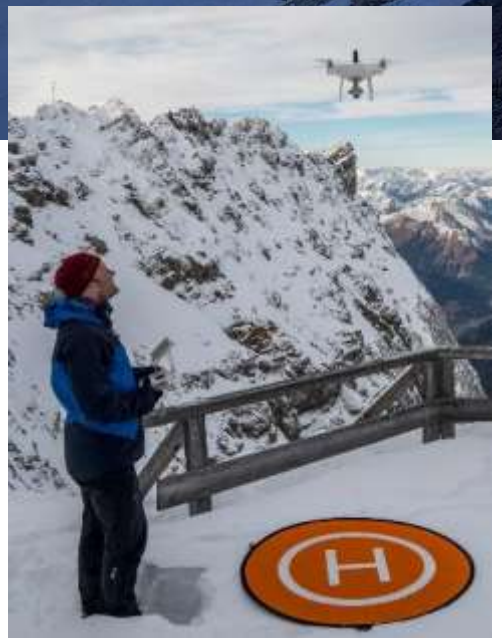


UAV for permafrost monitoring in high alpine regions within the new EU framework

Inga Beck, Robert Delleske, **Riccardo Scandroglio**, Erwin Lauschner, Till Rehm, Markus Keuschnig, Michael Krautblatter

UMWELT FORSCHUNGSSTATION SCHNEEFERNERHAUS

Technical University of Munich

GEORESEARCH

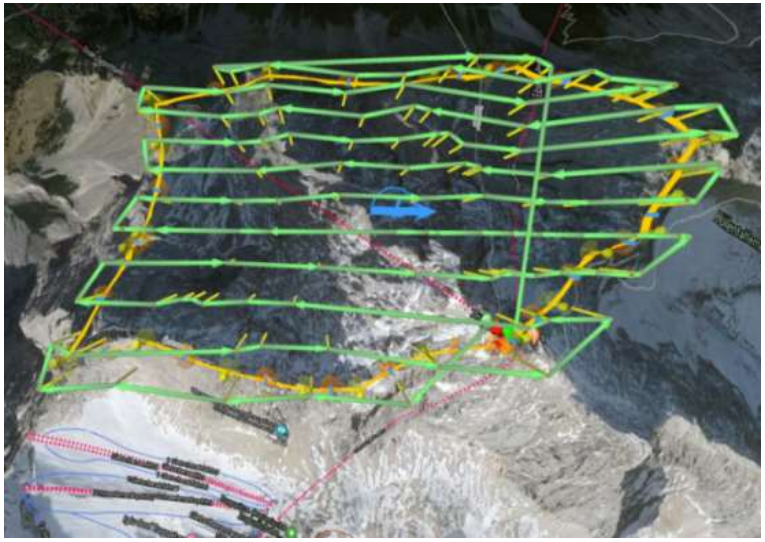
bavAIRia

Project scope, idea and aims

UAV operation

(i) in alpine regions and

(ii) in border areas (Germany-Austria)



- Fulfil administrative requirements

Detection of:

- interannual ground temperature changes
- snow accumulation
- areal permafrost occurrence
- rockfalls

Duration: Two years (2021 – 2023)

Partners

Lead and Coordination:
UFS GmbH - Environmental Research Station Schneefernerhaus

Technical & Scientific partners
GEORESEARCH mbH
TUM München, Landslides Group

Administrative support
bavAIRia e. V.

Funded by
Bavarian State Ministry of the Environment and Consumer Protection

Environmental Research Station Schneefernerhaus (UFS)

Established in 1999 at 2652 meters asl on the Zugspitze, it's Germany's highest research station.

High altitude research station for climate, atmo-, bio-, hydro- and geospheric research as well as for environment and altitude medicine.

Observatory for air pollutants, greenhouse gases, weather and natural phenomena.

Center for communication and meetings for teaching, education and sustainabilitly.


Photo: BG UFS GmbH

Monitoring permafrost from inside…

Temperature

Electrical Resistivity Tomography

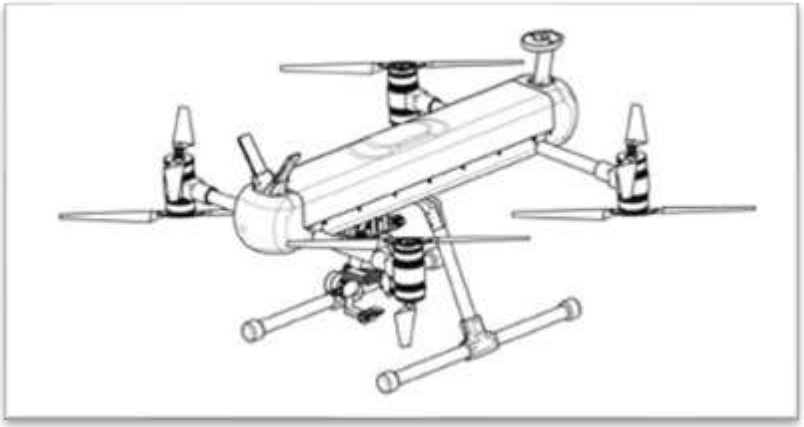
…and from the air.

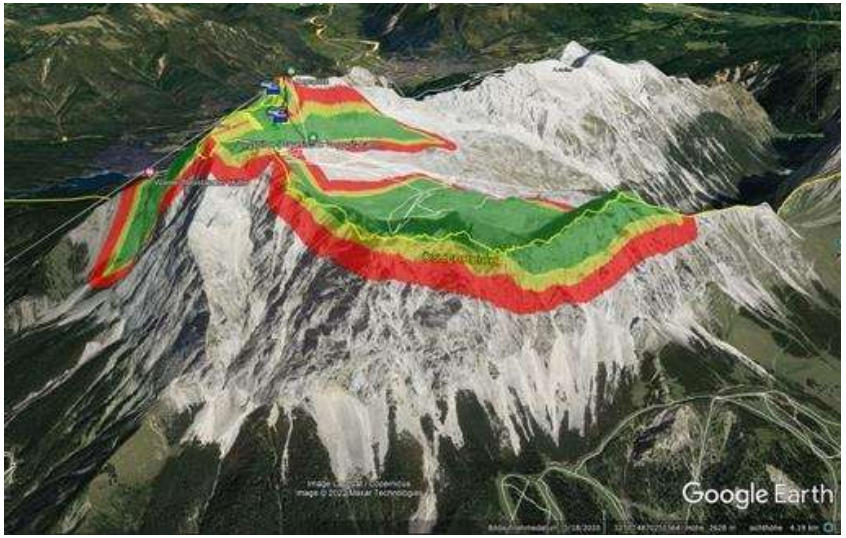
Drone: **coptersystem GEO**

Weight: 14 kg - Payload 3 kg

Sensors:

- **Optical** 20 MP
- **Thermal** 640x480 Pixel





Operation area

- Green = flight operation zone
- Yellow/Red = Risk Bufferzone

Challenges: high alpine areas and BVLOS

New European regulations (EASA - 1.1.2021) for drones allows in our project:

- **Cross border activities** with one single approval
  →Zugspitze: Germany/Austria
- **BVLOS** operations = Beyond Visual Line of Sight
  → 3 km distance for 17 kg drone

Requirements for secures and safe operations in airspace up to 200 m over ground:

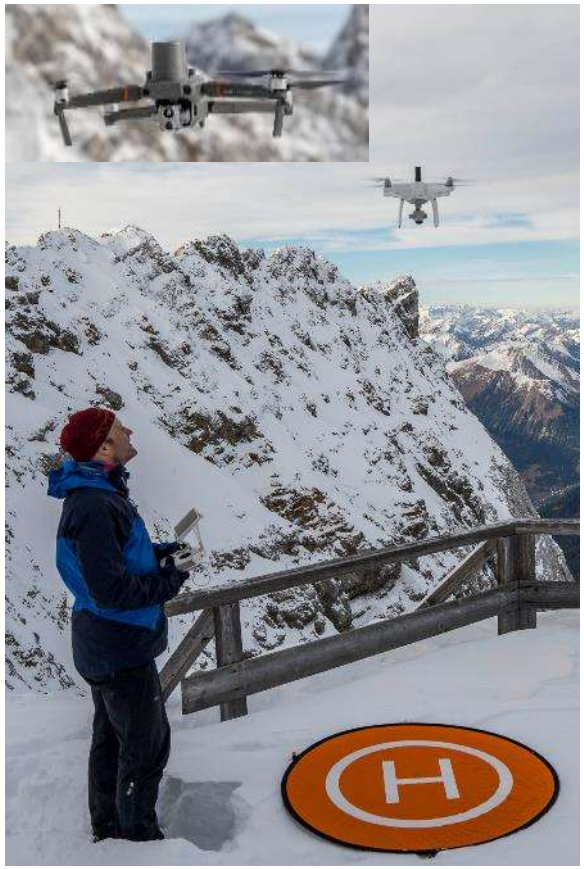
I. an elaborate operational description (Concept of Operations – **CONOPS**) and
II. a risk analysis (Specific Operations Risk Assessment – **SORA**).

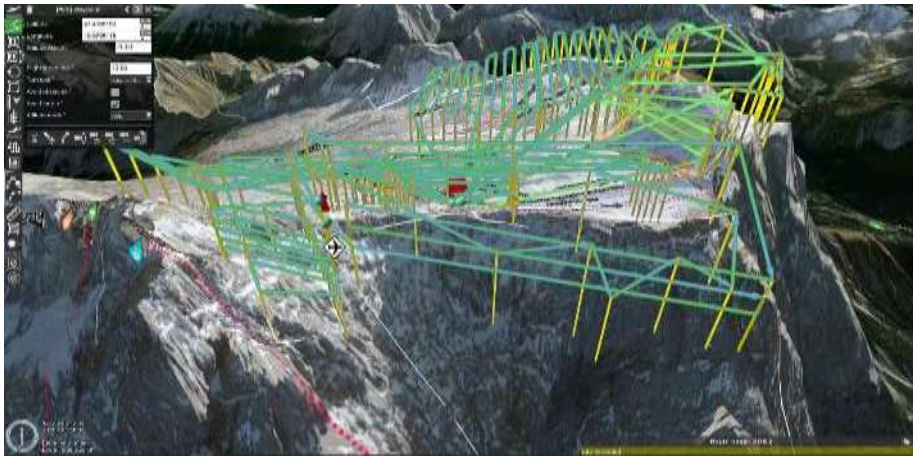
- Description of the operation.
- Evaluation of ground and air risks.
- Interaction with the air navigation service provider (ANSP).

Current status

So far:

- GCP installed
- Flight plan with UGCS (VLOS)
- First test flights with DJI UAVs (November 2021)
- Optical and Thermal sensors
- Steep north slope face and area around the research station



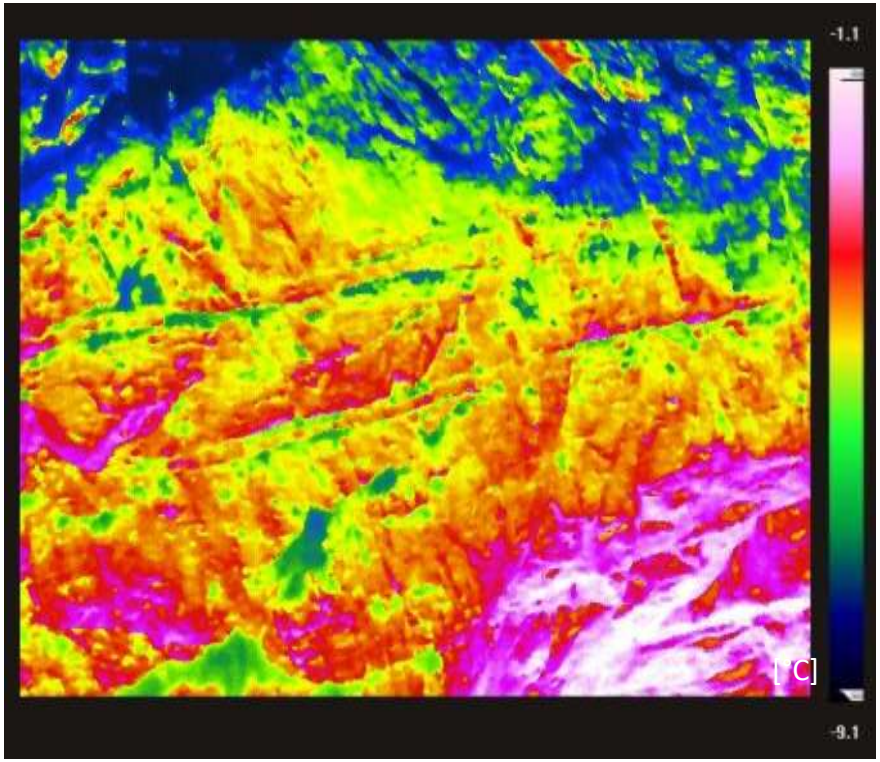


First results

Images:

Optical

Thermal



North Face of the Zugspitze Ridge

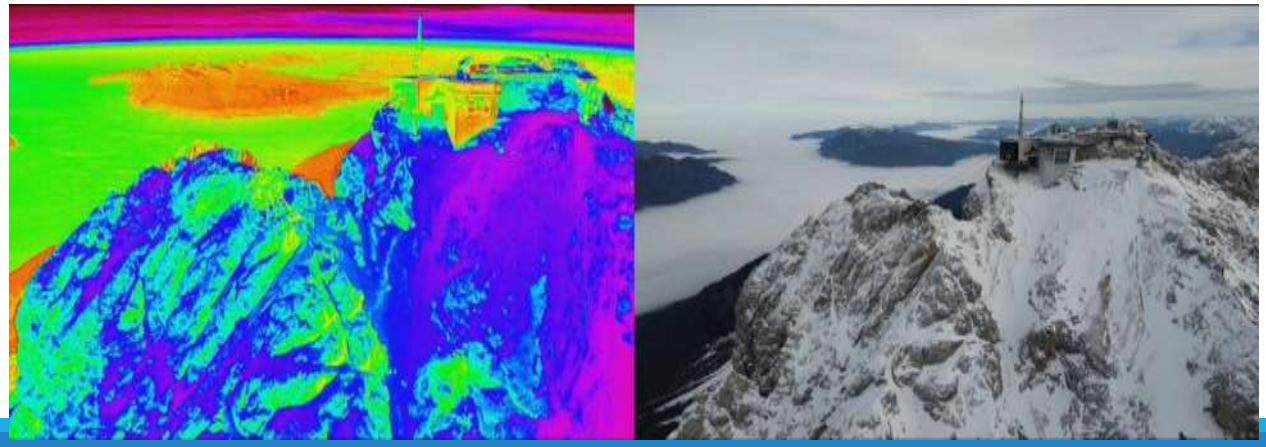
To come

Administratives:

- Sora / Conops → BVLOS Flights
- First fligh with the new copter

Research:

- **calibration** of thermal images → with samples in the laboratory
- thermal **monitoring** → daily and yearly
- **rockfall** inventary
- snow height



Thank you!

r.scandroglio@tum.de

Riccardo Scandroglio
Landslide Research Group
TU Munich