

## **Title: The Role of Temperature Variation for Reconstructing the Advance and Retreat of Glacial Ice using Thermal and Radar Imaging**

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### **Abstract**

The retreat of Earth's glaciers is an unmistakable bellwether of global climate change. Some of the most dramatic examples are in the Alps, where valley glaciers have shrunk or disappeared entirely over the past 20 years. Glacial retreat impacts planning for hydroelectric power and management of hazards due to flooding and avalanches. A major question is how entrained liquid water, and thus its latent heat, influence the flow regime (speed, ablation, seasonal behavior) of the advance and retreat of valley glaciers. Answering this question requires meeting the engineering and scientific challenge of how to measure temperature, and thus internal water distribution, in a complex polythermal (i.e., temperature varies with depth within the ice) glacier. Such a challenge involves areas that are hazardous and nearly inaccessible on foot, especially the "icefall zone" where ice flow is rapid and chaotically crevassed-essentially the birthplace of the valley glacier. We propose to use thermal infrared imaging to detect and map temperature distributions of liquid water deep within the crevasses of the icefall zone. Three-dimensional images of the scattering of electromagnetic energy will be produced with custom-built aerial ice-penetrating radar, which we have previously proven to be effective in detecting liquid water entrained within glacial ice. We will use UAV (Unmanned Aerial Vehicle) deployment of the radar and the thermal imager to test innovative strategies to working in a challenging physical environment, including hovering as close as possible over or within a crevasse field and flying loops or grid patterns over the icefall zone.